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Principles of Applied Psychology

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by

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To

F. K. P.

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J. R. P.

Preface

This successor to *Applied Psychology: Its Principles and Practice* reflects the great changes that have taken place in applied psychology within the last twenty years. It has attained a professional status in several of its branches, with a national society to safeguard and promote the interests of its practitioners, and with operating institutions to bring its facilities within the reach of those who can profitably use them. It has entered a state of maturity, having successfully passed through an adolescence whose "wild oats" are still being reaped but in rapidly decreasing amounts.

The volume of subject-matter has increased enormously as well as the number of persons who are actively engaged in research and practice. Books as large as the earlier edition of this one are now devoted to special applications within the field, so that it has become impossible to survey the whole body of literature within a single volume.

Out of this mass of material certain generalizations emerge which the author has ventured to call *principles.* It is these generalizations which he has attempted to present, illustrating them freely with research data. Since there has been no thought of presenting all the evidence, he has had to choose that which would serve his purpose best. Wherever feasible, early studies have been cited, thus giving recognition to pioneers whose contributions are often forgotten. Beyond that, the author has drawn heavily from the research of his own laboratory and frequently from the work of his own students. The reason for this resides not merely in the fact that he knows the material most intimately, but also in the fact that the researches were initiated in many instances to answer questions that naturally arose in the field of applied psychology.

The differential growth within the various subdivisions of applied psychology is reflected in the additional space allotted to them. The greatest growth has occurred in the so-called vocational and industrial fields, and in each of these three chapters have been added in addition to the expansion of the original ones. There is one new chapter in the section devoted to marketing to present the story of radio advertising and one in the section devoted to law to give an account of important studies of the judge and the jury. On the other hand, the original three chapters on general heredity, on family inheritance, and on sex

have been combined into one, and the two chapters on thinking and on suggestion have been combined into one. Altogether there are nine new chapters. Additional research material appears in sixty-seven new charts and in thirty new tables.

The book reflects more than the growth in quantity and quality of output and the number of workers in the field. It has incorporated in a more intimate fashion the growing recognition of, and respect for, the individual. These have always been the very foundation of democracy, and they have occupied a prominent place in both pure and applied psychology. Their significance has been magnified out of the ugly facts of the depression years and out of the repudiation of the individual by the totalitarian governments. It has now become all too clear that a successful social system demands the well-being, the comfort, and the satisfaction as well as the "work" of the individual.

The previous edition devoted a chapter of generous size to the question of satisfaction whereas it is now an integral part of every topic that is discussed. One possible shortcoming of the treatment of this matter may be noted. There may be a seeming overemphasis upon the satisfactions to be derived from the proper dealing with things and activities and too little emphasis upon the satisfactions that come from interactions with individuals, or the social factor. The influence of other individuals is not neglected—far from it—but since that falls within the traditional province of social psychology, the author gave it less space than might otherwise have been allotted to it.

The *Principles of Applied Psychology* can be read by the intelligent layman whose interest has been whetted by the common reference to the present period in history as the psychological era. He can read around the tables and charts and he can neglect the forbidding bibliography, although the last will aid him in pursuing a particular line of interest.

This survey should have something of value to contribute to the vocational counselor, the industrial engineer, and the personnel officer, in whose fields the human component looms larger with every passing day. Each of these professions may profit by seeing their problems from another angle.

The undergraduate who has had a good course in elementary psychology should experience no particular difficulty with the book especially if he has the guidance of a competent teacher. Although the author has a strong preference for the copious use of footnotes, he has eliminated these for the sake of greater readability. The references that would normally appear in footnotes have been gathered into the general bibliography, where they are alphabetically arranged and referred to by number.

If the author feels any favoritism among his prospective readers, it is directed toward the graduate student who is attracted by the prospects of becoming an applied psychologist. Applied psychology can support, in the coming years, many able investigators and technologists. By taking advantage of all that this book has to offer, they can find the means of acquiring an historical perspective, a picture of current trends, and a glimpse into the realm of important research that badly needs doing. These values are not so much on the surface as they are buried in tables and charts, in bibliographic references, and in research suggestions. The critically minded student will soon discover that the findings which rest on thoroughly sound research are few and that the principles that are definitely established are fewer still. But it is just this state of affairs that makes a field of work attractive—so relatively little accomplished, so much still to do, and the need so very great.

Both authors and publishers have been generous and coöperative in giving permission for the use of materials. Acknowledgments have been made of specific sources in connection with the tables, charts, and quotations. For ideas and suggestions that have come from reading and discussion over the years, acknowledgment can never be specifically made. The author herewith acknowledges his debt of gratitude to all those from whom he has profited in this less tangible fashion.

A. T. P.

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The Field of Applied Psychology

PSYCHOLOGY AND EVERYDAY LIFE

The first decade of the twentieth century marked the culmination of a shift in the subject-matter of psychology from mind to behavior. The shift was not sudden nor was it solely the product of the Behaviorist movement. The latter movement was rather the climax to changes which began during the last two decades of the nineteenth century. Behavior manifestations of mind had become more and more the objects of study until they acquired an interest status of their own and finally mind or mental reactions came to be treated as instances of behavior. One of the remarkable consequences of this shift of emphasis and of the broadening of the concept of behavior has been that the behavior of people the world over and not some highly abstract behavior in the laboratory became the subject-matter of psychology.

This evolution in the concepts of psychology was taking place against an historical background in which social changes were occurring at a terrifying pace. The first third of the present century is thus characterized in *Recent Social Trends in the United States* (*510,* xi):

> The first third of the twentieth century has been filled with epoch-making events and crowded with problems of great variety and complexity. The World War, the inflation and deflation of agriculture and business, our emergence as a creditor nation, the spectacular increase in efficiency and productivity and the tragic spread of unemployment and business distress, the experiment of prohibition, birth control, race riots, stoppage of immigration, women's suffrage, the struggles of the Progressive and Farm Labor parties, governmental corruption, crime and racketeering, the sprawl of great cities, the decadence of rural government, the birth of the League of Nations, the expansion of education, the rise and weakening of organized labor, the growth of spectacular fortunes, the advance of medical science, the emphasis on sports and recreation, the renewed interest in child welfare—these are a few of the many happenings, which have marked one of the most eventful periods of our history.

It should not be surprising that the problems of our rapidly changing social and economic structures have been so generally recognized to be

psychological problems. The psychological implications in the following questions may be readily seen (*234*):

1. To what extent does the success of a democracy depend upon the distribution of intelligence among its citizens and to what extent is this intelligence distribution modifiable through education?
2. Are certain races of man inherently superior to others in intelligence?
3. Is war the consequence of deeply rooted human instincts and therefore inevitable?
4. Must a successful society depend for its motivation upon native aggression and competitive tendencies within individuals?
5. Are criminals born so or are they the products of unfortunate training? If the latter, what are the factors that contribute to the making of a criminal career?
6. What are the problems that are peculiar to the adjustments in old age?
7. What can be done to soften the effects of technological changes upon health and satisfaction?

Kelley (*336*), in analyzing the problems of democracy, asks whether it is possible for a democracy to preserve such individual values and benefits that the citizen will fight and sacrifice to keep them.

> The writer believes that it is possible, and that an essential key to its accomplishment is through self-expression so rich as to be utterly desirable to the individual and so efficient as to be completely contributive to state welfare. . . . The democratic problem that we set is so to utilize the talents of our differentially endowed and trained citizens as to maximize their satisfactions and their social productivity. That is to say, we seek a mode of individual functioning which gives the dual return of satisfaction and welfare to the individual and goods and attitudes of value to society.

In this statement of the key to a successful democracy one finds the essence of applied psychology, namely *the recognition of individual differences in endowment and in training, and the need for the adjustment of each individual in life so as to furnish to him the maximum of satisfaction and to society the maximum of desirable goods*. The practical problem of adjustment arises out of the fact of individual differences, since it is obvious that if all people were alike, adjusting the one and only type would be a simple matter indeed.

One important aspect of adjustment that is not explicitly indicated in the statement of Kelley is that it implies a fitting of the environment to the individual as well as of the individual to the environment.

PSYCHOLOGY AND PSYCHOTECHNOLOGY

The question has frequently been raised whether applied psychology is really sufficiently different from pure psychology to warrant giving it an independent status. Certainly it is not just another system of psy-

chology to be added to the list of Structural, Dynamic, Behavior, Gestalt, and others. It cannot be a systematically organized body of material, but at any moment will consist of the sum total of applications that have been made, are being made, or that can be made. For that reason one might better speak of Applications of Psychology rather than of Applied Psychology for that designation would be less misleading in its implications.

Applied psychology can be characterized as a technology resting upon the science of psychology. Münsterberg (*444*), in his *Psychotechnik,* made a distinction between theoretical psychology, applied psychology, and psychotechnics. The first is what is known as pure or general psychology. The second consists in the explanation by psychological laws of past events and the facts of other sciences. For example, the explanation of certain historical movements or historical characters by appeal to psychology, and the application of the laws of psychology to the physics of color would be called applied psychology. Likewise, the application of the laws of mathematics to astronomy or the laws of chemistry to physiology would be applied science. Technics, on the other hand, would be represented by the application of the laws of mathematics to the construction of electrical machines for lighting purposes, or by the application of the laws of chemistry to the making of dyestuffs or medicines. In a similar manner Münsterberg would define psychotechnics as the application of psychology to the solution of practical problems.

Such a distinction is a limited one, since every scientific discovery has the possibility of leading to some practical application, so that sooner or later it will determine a future course of events for practical life. The scientific construction of medicines demands that the science of chemistry shall first have been applied to physiological processes. When this has been done, in a given concrete situation, examination will show what is lacking in the human organism, or what mechanism is functioning improperly, and medicines may be administered accordingly. Likewise, the proper blending of color dyes in the dyeing and printing of cloth and in the construction of aesthetic color patterns requires that the psychological laws of color contrast shall first have been applied to the physics of light mixture and the chemistry of dyes. Applied psychology and psychotechnics thus become coextensive and even these two differ from psychology proper largely in the immediacy or remoteness of applicability.

More recently Gundlach (*233*) made somewhat the same distinction between psychology and psychotechnology. He says that the scientific man is typically not concerned with particular workaday problems but with general principles and knowledge. He is disinterested and imper-

sonal, and is willing to follow the data of his problem no matter where they may lead. His aim is to describe and understand nature. The technologist, on the other hand, has a specific interest in the outcome. His problem is to get certain results such as building a bridge or curing a patient. He must not be distracted into following interesting leads as they arise because such diversions might interfere with the attainment of his practical ends.

Gundlach introduces an additional note into the concept of a technology by placing upon it a certain ethical responsibility for the goodness of the recommendations that it makes. It is not enough for the technologist to say that *if you want to build a bridge* this is the way to do it, but he should consider the advisability of building it at all. Such ethical responsibility has always been inherent in the profession of medicine. It is clearly expressed in the Hippocratic oath administered to every graduate in medicine. It is growing in the profession of engineering as indicated by the introduction of Philosophy, Social Science, and humanistic subjects into the engineering curriculum with the intention that they shall become the foundation for professional ideals and professional ethics (*308*). It is equally important that the psychotechnologist should build upon such a sound professional basis and there is evidence that he is doing so. The functioning of psychotechnology would then be, according to Gundlach, "to determine the conditions of living necessary for a complete and satisfactory life, and to elaborate the methods for such attainment."

To the beginning student of psychology, the two fields of pure and applied psychology are not sharply distinguished. This is due in part to the fact that the teacher draws his illustrative materials in pure psychology largely from the researches of the applied psychologist because these are closer to the everyday experiences of the student and are likely to be the more interesting on that account. In the minds of the textbook writers, moreover, the pure and the applied fields are not always sharply distinguished. Thus, William McDougall (*411*), who would hardly be labeled as an applied psychologist, defined the aim of psychology thus: "To render our knowledge of human nature more exact and more systematic, in order that we may control ourselves more wisely and influence our fellowmen more effectively." The second clause in this statement is a fair expression of the aim of applied psychology.

For the prospective psychotechnologist, there is a very real difference between the two fields. In solving a practical problem it is seldom enough to take from the psychological laboratory either a finding and consider it the answer, or a method and consider that an adequate means for finding an answer. At the least, a high degree of flexibility

and ingenuity is required to fit these into the needs of the practical situation. Two simple instances will illustrate the difference. What is the most appropriate color to use in advertising a certain commodity to be sold to women? An answer could be obtained immediately from the laboratory data on sex differences in color preferences, or if such facts were not at hand, one of the stock preference measuring methods could be used under laboratory conditions. A proper applied technique would be to prepare a series of advertisements in different colors or color combinations and to measure the preferences of a sampling of the prospective consumers of the commodity. The outcome might be identical with that of the laboratory experiment but on the other hand it might be entirely different.

What is the significance of the reaction time of the driver in automobile accidents? One could go to the laboratory records and find the distribution curves for reactions of various sorts, the simple, the discrimination, and the choice reactions. Having decided that the driver employs choice reactions, he could compute what percentage of the distribution curve would have reactions too slow to avoid accidents when the car is traveling at given speeds. Then he could measure the reaction times of drivers under the customary laboratory conditions and classify them into the fit and the unfit. The psychotechnician on the other hand would ask himself whether the process of discriminating among objects on the highway, the process of choosing an appropriate set of motions, and the process of consummating the reaction would have time values similar to those in the laboratory. Not being able to answer this question he would set up a reaction-time road test for his practical purpose (*439*).

THE GROWTH OF APPLIED PSYCHOLOGY

The history of applied psychology may be divided roughly into epochs or stages. One cannot mark off any definite period when it came into existence. In some crude form or other it has probably existed as long as men were able to formulate any laws of the mind, whether these laws were correct or not. But one can mark off four periods more or less clearly up to the present.

1. Long before the time of experimental psychology, persons were accustomed to make use of very vague notions of the workings of the mind in the problems of daily life. The mind was supposed to be subject to the influence of all kinds of outside forces, those of inanimate and animate objects, and consequently people's behavior was influenced by superstitions and myths. Breaking mirrors, spilling salt, putting up an umbrella in the house, getting married on Friday, being a member

of a party of thirteen, and the like were unlucky factors in one's experience, and in fact are still considered so by many persons.

That one cannot work so well when tired as when rested, that the memory of one person is better than that of others, that some persons are stupid and others bright, are notions that were applied to daily life before they were subjected to scientific test in the laboratory.

2. After experimental psychology had developed and a mass of standard experiments had accumulated, there was a tendency to apply these experiments directly to other fields, just as physiological and physical experiments were carried over directly into the psychological laboratory at its beginning. This tendency was perhaps most noticeable in education and medicine. For instance, education took over directly the experiments in memory, imagination, and attention and tried to use them in solving educational problems. In the attempts to measure any form of complex activity, the procedure consisted in applying a large number of the standard laboratory tests to persons of varying ability in the particular activity. Then those tests that were well done by the experts and poorly done by those known to be poor in the work, were considered good tests of that kind of ability. This procedure is still of much value and is used where it has been impossible to analyze a complex form of activity into its elements. In such cases the best that can be done is to proceed in a random fashion in the hope that a few tests will be discovered which will serve as indices of particular ability. The relationships thus disclosed do not necessarily mean that the function tested is a vital part of the process, but for some reason it serves as a symptom, in much the same manner that rose-colored spots on the skin once served as a symptom in the diagnosis of typhoid fever.

3. In the third period the practical problems themselves are studied and the actual life situations form the material of the experiment. This is the present stage, and might with much justification be considered the beginning of a real applied psychology. In fact, Paterson (*484*), in reviewing its history, says exactly that. He divides the life-cycle of applied psychology into four periods. The first he calls the prenatal period, in which the first sign of life appeared, extending from the last two decades of the nineteenth century until America's entrance in the World War in 1917. The second he calls the birth period, which ended with the Armistice in November 1918. The third he dramatizes as the period of childhood and adolescence, which extended through the boom and depression years and closed with 1937, the date of the creation of a national organization devoted to its interests, The American Association for Applied Psychology. This date, likewise, marks the entrance of applied psychology into its fourth period in which it attained the full stature of adulthood.

This portrayal of the development of applied psychology emphasizes its really remarkable growth since 1917, a growth resulting in large measure from the success of the psychological testing program and the program of personnel classification in the army. In addition to these specific factors, Paterson (*484*) points out a more pervasive influence:

> We must not leave the topic of Military Psychology without mentioning the fact that psychologists in the Army learned for the first time how to pool their efforts and how to coöperate with physicians, psychiatrists, line officers and practical men of affairs They discovered that coöperation is not only possible but indispensable for carrying out large-scale operations. It is not surprising, therefore, to note that the post-war development of applied psychology was characterized by the rise of organized psychological service. This trend is so pronounced that we can sketch the history of applied psychology during the past twenty-one years without mentioning individuals at all but simply by mentioning well-known services.

Among such psychological services are those in business and industrial personnel; in education; in child guidance clinics and institutes for child welfare; in federal and state employment offices; in youth and adult guidance clinics; in hospitals; in courts; in federal, state, and local prisons; in advertising agencies and market research bureaus; in federal departments such as the Department of Labor and the Department of Agriculture; and in Federal Bureaus, including the United States Civil Service and the Social Security Board.

One of the most unique of the institutions devoted to applied psychology is the Psychological Corporation, a non-profit institution incorporated in the State of New York, whose objects, as stated in its constitution, are:

> ... the advancement of psychology and the promotion of the useful applications of psychology. It is organized as a business corporation but not for the individual profit of the incorporators, stockholders, or directors, beyond reasonable compensation for services rendered ... It will promote the advancement of psychology by research, the more effective organization of psychological work, and the diffusion of knowledge concerning psychology.

Its board of Directors is composed of past presidents of the American Psychological Association, and its officers serve without compensation. It offers service in market research, personnel and employment research, vocational counseling, test construction and distribution, industrial research, and psychological testing of candidates for nurses' training. Its work is done in a central office in New York City coöperating with several hundred psychologists in various parts of the United States. It is the joint publisher and editor of the *Journal of Applied Psychology* in which its researches are frequently reported.

Another unique institution is the American Association for Applied

Psychology which was organized in 1937, a professional society devoted to the promotion of work in applied psychology and with a membership of about 600. In addition to the national organization there are many state and city branches which concern themselves with the more local problems. Of the approximately 3,000 members of the American Psychological Association, from one third to one half are engaged in some form of non-academic work which in most instances would be labeled as applied psychology.

The growth in the applications of psychology is not peculiar to the United States alone. Before the great social upheaval of the 1930-1940 decade there were known to be organizations similar to one or the other just described in many foreign countries, notably, England, Germany, France, Switzerland, Spain, Russia, Japan, and Australia. The National Institute of Industrial Psychology in England has been outstanding in its contributions to research and service. Its journal, at present called *Occupational Psychology,* is one of the most important sources of material on applied psychology.

APPLIED PSYCHOLOGY AND INDIVIDUAL DIFFERENCES

The problems of applied psychology are problems of adjustment of individuals and groups of individuals to life situations, whether the adjustment be in the nature of fitting a given individual to a given particular environment or vice versa, or whether it be in the nature of modifying each one to fit the other. The magnitude of this adjustment program rests upon the fact that individuals differ one from another in every respect in which they have been measured. If all individuals were alike and only their environment varied or could be varied, the adjustment problem could be solved more or less completely by fitting any one individual, as a sample of all others, to the varying environment. But one's common sense observation tells him that people are not all alike, and told him so long before there were any standardized devices for measuring differences. Hull (*297,* 5) reminds the psychologist that Plato in his *Republic* noted that no two persons are born exactly alike, one being suited to one occupation and another to another, and that an attempt should be made to put each person into the niche where he would fit best. Common sense would also suggest that these differences are of a magnitude sufficiently great to demand consideration in dealing with people.

When one passes beyond common-sense observations, it becomes extremely difficult to give acceptable estimates of the degree of the differences (*204*). The most serious obstacle to doing this is the absence of an absolute zero point from which to measure the amount of a trait.

Certain anatomical, physiological, and motor functions can be measured in accepted physical units, but this is not the case with most human performances. The absence of such a zero point is particularly disturbing in estimating range of proficiency. Anastasi (*9*, 54-55) has demonstrated the difficulty clearly in supposing the measurement of height with a device where the "working zero" was not absolute zero height but was some arbitrary point such as two feet. Then a six-foot person would measure four feet on this scale, a four-foot person would measure two feet, and the former would appear to be twice as tall as the latter. Actually, he would be only one and one-half times as tall. This and other difficulties have led Anastasi to conclude that in the present stage of mental testing the question of the extent of individual differences in various traits cannot be answered at all.

Answers have been given, nevertheless, and in spite of the errors inherent in them, probably represent fairly well the ranges for different functions. Hull (*297*, 36), for instance, has collected from the literature a set of ratios of best to poorest in a variety of functions. For a group of thirteen scholastic achievement tests, such as reading, writing, arithmetic, and spelling, administered to eighth-grade children, the average ratio of best to poorest is 3.5 to 1. For a group of thirty-four psychological tests administered to ninth-grade children, the average ratio of best to poorest is 5.2 to 1. For a series of nine gainful occupations such as loom operation, shoe-making, and office work the average ratio of best to poorest is 2 to 1. He concludes from these cases that: "Among individuals ordinarily regarded as normal, in the average vocation the most gifted will be between three and four times as capable as the poorest."

Wechsler (*685*, 50), on the other hand, considers these estimates too high. He chooses as an expression of the range of proficiency the ratio of the 999th to the second individual in a thousand, and after taking certain precautions as to homogeneity of populations and the elimination of the obviously abnormal deviates, he finds that the majority of the total range ratios fall within the limits of 1.3 to 1 and 2.5 to 1. The more strictly mental functions listed by him such as the perceptual and intellectual abilities, show the largest range of all, namely between 2.30 to 1 and 2.85 to 1. His general estimate would be a range of about 2 to 1. Even this small figure would fully justify the consideration of individual differences as factors in successful performance and in personal satisfaction. A more recent compilation by Thorndike (*626*, 257-264) of the range within each of a great variety of human traits rightly emphasizes the differences in range among the traits, but does not lessen the significance to be attached to the differences.

In addition to the range of proficiency among individuals with

respect to any one task, there needs to be considered the range of abilities within any one person. Adequate adjustment would mean the opportunity to express oneself in that function which is possessed to the maximal degree. The common-sense view would be that a person is not uniformly endowed in all respects but that he can do some things distinctly better than others. Such observations do not in any sense imply the notion of compensatory development, by which a person low in one respect will be necessarily high in others.

The calculation of the range of capacities within the individual is subject to all the difficulties previously mentioned, with the added one that the measures of the many abilities would have to be made comparable one with another. Various techniques have been devised for this purpose. Hull, after taking the many complicating factors into account, ventures the estimate that trait differences within the individual average approximately 80 per cent as great as individual differences, which would make the average range between the best and the poorest ability from about 2.5 or 3 to 1.

There is still another type of variation which plays a part in adjustment, namely the variation within an individual in any given ability at different times and under different circumstances. A question might be stated thus: How uniform is a person's performance from time to time? Any individual knows that level of achievement varies considerably with changes in health, with intoxication, with fatigue, with practice, with changes in incentive to performance, with the presence or absence of distractions, and under many other circumstances. When adequate adjustment is the goal such factors as these may not be excluded from the picture. Influences such as those just mentioned might well reduce performance from a high level to zero so that there is little sense in attempting to make estimates of their effects. But it is pertinent to mention the findings of Hollingworth (*268*, 194-195) concerning the extent of variation within an individual when all such conditions as are listed above are carefully controlled and when the effects of practice have been eliminated by long training. According to him:

> The magnitude of the deviations in the performance of an individual need not be expected to be so great as that for a group of subjects chosen entirely at random. But there is no present reason for supposing that even this magnitude will not closely resemble that in the case of a group of individuals of the same general class.

And further:

> Individuals seem to vary from their own average in quite the same way that they differ from the central tendency of their group. The degree to which this is the case may vary with the nature of the process.

CAUSES OF INDIVIDUAL DIFFERENCES

One cannot accept the existence of individual differences and note their magnitude without inquiring as to their causes. Are they inevitable in the make-up of the human population or could they be changed in magnitude or eliminated entirely if that should seem to be desirable? This is not a merely academic question. To be sure, the present generation is what it is and little or nothing can be done about the differences that exist among its members except to make adjustments for them. But if the magnitude of human abilities is only a matter of adequate control, a few generations would be enough to modify them into a more satisfactory pattern. Unfortunately the causes of individual differences cannot yet be entirely unraveled. There is insufficient basis for saying that they are due solely to the native endowment of the individual or that they are due solely to environmental influences, although proponents could be found for either point of view. Somewhere between these extremes the answer will be found. Just now the controversy is most acute concerning the causes of differences in intelligence and the crucial experiment to settle the question has not yet been devised. It is the old nature-nurture controversy. If settled once and for all for intelligence the way will be open for a more speedy attack upon other differences which are equally great and equally important in successful living. The whole problem will be dealt with in Chapter 2, and it is mentioned here merely to show its bearing upon the probable future of applied psychology.

THE RECOGNITION OF INDIVIDUAL DIFFERENCES

One further question has to do with the extent to which such differences are recognized and allowed for in modern society. To the student of psychology, the existence of the differences is so obvious and the need to take them into account so equally obvious that he may be inclined to think that every one else is alive to their significance. Although differences in the make-up of people were clearly recognized by Plato and Aristotle, in succeeding centuries they were for one reason or another ignored and only came to have an influence upon practical life in the latter part of the eighteenth and the beginning of the nineteenth centuries, with the educational theories of Rousseau, Froebel, and others. In the latter part of the nineteenth century Francis Galton, aroused by Charles Darwin's studies of physical differences, sought for and found individual differences in mental functions. Since that time the continuing development of mental tests in the greatest variety has shown individual differences to exist in every measured function.

In spite of such evidence that all people are not alike, there was the inevitable lag of twenty-five to fifty years in the acceptance of this fact into the thinking and action of everyday life. The slogan that all men are born free and equal was taken literally to mean that all people are fundamentally alike, and overshadowed the findings of the scientific laboratories to the contrary. With the twentieth century, progressive educators began to apply the concept of individuality in the teaching process and the progressive efficiency engineers made a start toward introducing the same concept into business and industry. In the more enlightened public schools the influence of this movement may be seen in the introduction of technical and vocational programs along with the more classical courses, and of classes for retarded and for advanced children. In the college one may find freedom of election of courses of study, the division of classes according to capacity level, placement examinations, and a definite trend toward individual instruction at least in the last two college years with tutors or advisors to confer with the individual students. The clearest evidence of the movement in business and industry appears in the rise of the personnel officer whose business it is to select employees, to train them, to adjust them to working conditions, to follow their records, and to shift them about if adjustment can be improved thereby. But both in education and in business and industry the concept of individuality has been relatively slow in gaining a foothold, and its influence is still local rather than widespread.

The routine of everyday living seems to conform to the notion that all people are alike and many of the forces that constitute the social environment would tend to make them so. The standardization and universality of radio and motion-picture programs, and the huge circulation of certain newspapers and magazines provide a uniform diet. If these media of communication were to be used for propaganda purposes they might regiment a whole population into a standardized pattern of thought and action (*382*). Even aesthetic appreciation may be on the road toward standardization, with the growth of literary guilds, book of the month clubs, music of the month clubs, and pictures of the month clubs.

A DEFINITION OF APPLIED PSYCHOLOGY

The preceding observations provide a background for the delimitation of the field of applied psychology and for the formulation of a tentative plan of organization of its subject-matter. It will be necessary to satisfy the requirements for human planning which, according to Doob (*143*, 6), are to acquire:

1. A knowledge of the people who will be affected.
2. A knowledge of the physical and social environments confronting these people.
3. A knowledge of the goal to be achieved.

Kelley's statement (*336*) that the problem of democracy is "so to utilize the talents of our differentially endowed and trained citizens as to maximize their satisfactions and their social productivity," can be modified thus: *The problem of applied psychology is so to adjust differentially endowed individuals by training them, by selection of their environment, and by the control of this environment that they may attain the maximum of social productivity and the maximum of personal satisfaction.* This definition recognizes that individuals differ by native constitution in respect to what they can do and enjoy doing, that their patterns of behavior may be developed through training, that manifold environmental forces influence their performance, that many of these can and should be controlled; and further that it is the proper destiny of every individual to be productive for the welfare of society and that in return he is entitled to the maximum of satisfaction which this society can provide.

Any plan for dealing with such an extensive subject-matter will necessarily be arbitrary and incomplete and will have to be flexible enough to change as knowledge increases. However, it seems entirely feasible to set down certain principles which will apply in attaining the goal of adequate adjustment. Thus, the consequence of having a certain remote and family ancestry, of being of a certain age and sex, of having to acquire habits and ideas according to the laws of learning will be specified. The probable effects of certain environmental conditions such as illumination, ventilation, and noise will be listed as well as the effects of modifying them. The influence of work, rest, and sleep, and of drugs and stimulants upon the human economy will be disclosed and allowed for. The means by which one can be directed into the vocation where he will fit best, and the conditions necessary for his efficient performance there will be described in so far as they are known. Certain maladjustments such as make one unfit for productive service or bring him into conflict with the law will be interpreted and methods of dealing with them will be examined. Finally, certain general observations upon the educational process as a means of making the most out of each and every unique individual will be made in the light of all the other topics previously discussed. This program will leave any specialized problems of adjustment untouched, but should give some useful hints even in these cases as to the methods which might be found useful in their solution.

2

Hereditary Conditions of Adjustment

Two facts should have been carried over from the survey of the field of applied psychology. The first is that the function of applied psychology is human adjustment, and the second is that individuals differ significantly in the adequacy of their adjustments. The word adjustment implies two terms and a dynamic relationship between them. There is the human organism and there is its environment, using that term in a very broad sense; and there is the process of fitting the two together. Our task will be to understand the characteristics of the organism in so far as they concern its adjustment, the characteristics of the environment in so far as they must be adjusted to, or be themselves modified or controlled, and the process by which the adjustments can be made. The first of these three tasks will be dealt with in this chapter.

NEED FOR CHOOSING A LEVEL OF INTERPRETATION

Two difficulties are encountered in attempting to understand the organism. The first has to do with the level of interpretation upon which the inquiry shall be staged. In regard to structure shall one be concerned with atoms and their components, with cells, with organs, with the organism, or with a society of which the organism is one unit? Advocates can be found for thinking on any one of these levels. And as for functions, shall one seek the lowest and most fundamental level of events and discuss the attraction and repulsion among like and unlike charged particles? Shall one be concerned with chemical sufficiencies or insufficiencies of cells and body fluids? Shall one speak of body needs as for water and salts? Or shall one turn one's inquiries in the direction of human experiences such as the experience of thirst and hunger or, on a higher level still, the desire for food and drink? Neither in the case of structure nor of functions is one frame of reference right and the others wrong—one is as legitimate as the others (*79*, 22-23). The division of labor among the sciences brings it about that the first level

has seemed most appropriate for the physicist, the second for the chemist, the third for the physiologist, and the remainder for the psychologist unless the last one should be claimed by the philosopher. The applied psychologist who deals most commonly with people as they are and in life situations is entitled to the privilege of considering adjustment on the plane of needs, wants, and desires.

THE HEREDITY-ENVIRONMENT DILEMMA

A second difficulty grows out of the question as to how much of the mechanism of adjustment is predetermined for the individual and how much of it is acquired early or late in his lifetime. A further question arises also concerning the modifiability of those patterns of reaction which are accepted as part of the native endowment. The geneticist, taking off from the research of the biologist upon the mechanisms of inheritance, places a heavy responsibility upon the native endowment of the individual. He looks to the improvement of the racial stock by selective breeding, as set forth in the principles of Eugenics (*475*), for the improvement of adjustment. Birth control and sterilization are means to this end. The psychologist, having been bequeathed a whole catalogue of native characteristics, or interests, from the period when observation of animals, young children, and adolescents was an accepted mode of research, has fluctuated between acceptance of the list (*622,* Vol. I) and rejection of it (*682*). The concept of the conditioned reflex has seemed to offer a process by which behavior formerly thought to be native might have been acquired (*269*) (*289*).

Search for unlearned behavior patterns and for evidences of early learning has led psychologists to investigate the behavior of the human foetus (*432*) and to supplement the data thus acquired with studies of animal embryos (*87*). Although the results from such studies as these have not led to the ready solution of the nature-nurture problem that was anticipated, nevertheless, the evidence demands serious consideration.

Other investigators have adopted a different approach to the problem and have made an intensive attack upon a special function. For instance, attempts have been made to study the effects of training upon intelligence when heredity is held constant as in the case of identical twins, and the effects of heredity when environment is held constant as with children raised in institutions (*712*). Results of studies of this type are difficult to evaluate at the present time.

Anthropologists have attacked the nature-nurture problem from still another angle. They have looked for the manifestation of some human trait, that is supposed to be universally present, in certain primitive

races whose cultures differ. Thus competition, or the competitive instinct, has been evaluated in thirteen cultures by Mead (*422*) and a group of collaborators. The data derived from this approach, instead of providing a definite answer to the problem, raise a whole series of questions which, according to May and Doob (*402*), call for further intensive research.

The applied psychologist need not withhold his services until all the doubts about origins and universality are dissipated. At the worst he can limit his activities within one cultural area, make mass predictions only in regard to those characteristics that are practically universal within that area, and he can keep his predictions within such temporal limits as to escape pronounced cultural upheavals. As for predictions about the individual, he can take him as he finds him, making what use he can of insight into cause and effect for purposes of diagnosis and prognosis.

FUNDAMENTAL CHARACTERISTICS OF HUMAN NATURE

There are certain characteristics of the human mechanism that can be listed as native with a fair degree of assurance. Such are the following.

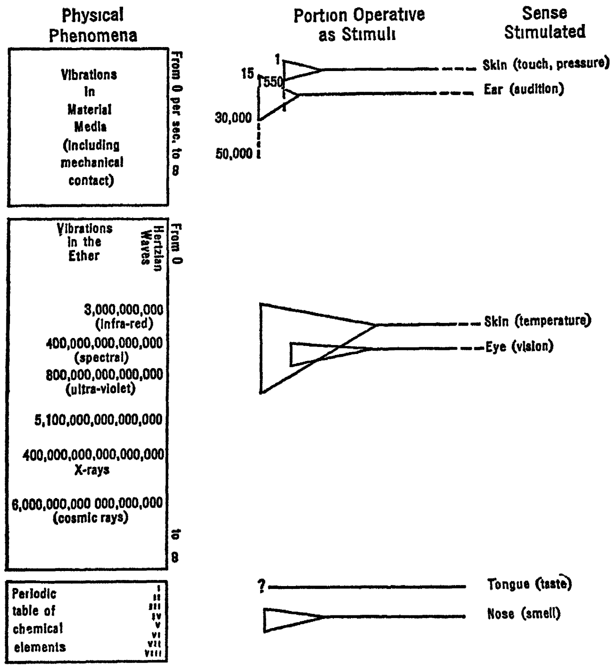
1. The normal human being is endowed by nature with certain sensitivities to his environment whereas he lacks others that he might have had. This means that one is born with a limited number of sense organs and a brain structure such that certain stimuli produce specific forms of reaction. The fact is so obvious that it is likely to be taken for granted and its significance overlooked. One way to realize the limitations of human sensitivities is to inspect the range of events in nature that fall beyond the "reach" of human sensory equipment. Figure 1, adapted from Freeman (*184*, 70), will aid the reader in doing this. The column on the left shows the range of physical phenomena; the second column shows the portions of that range which operate as stimuli; and the third column shows the sense that is affected. The sensitivity gaps that are most striking today are perhaps the visual inadequacies for the infra-red rays and the ultra-violet rays. Both have recently been brought within the range of our senses by indirect means, the former by way of infra-red photography and the latter by way of fluorescent illumination. One way to realize the significance of those sensitivities that we do possess is to perceive the change in behavior caused by the failure of any of the sensory mechanisms to function properly, as in the case of congenital blindness and congenital deafness.

Not only is the kind of sensitivity predetermined for the individual,

but also the fineness of each kind has its natural limits. People seem to be born with a dead-line of sensitivity to sound and to differences in sound intensity and in pitch, and with a dead-line of sensitivity to light and to small changes in the intensity of light. There are, doubtless, limits within the other senses as well although they have not been so definitely determined. The natural limitation within individuals in these respects may set the limits of their achievement in music, in art, in sports, and in many trades and professions.

FIGURE 1

LIMITATIONS OF HUMAN SENSITIVITY TO PHYSICAL STIMULI *



* Adapted from G. L. Freeman, *Introduction to Physiological Psychology* (New York, The Ronald Press Co , 1934), p. 70

2. Another characteristic of original nature provides that out of all the stimuli which affect the sense organs certain ones will come clearly into consciousness, whereas others will be crowded out. This means that there is a tendency to pay attention to certain kinds of stimuli and that others tend to be neglected.

Such natural attention is of the greatest importance, for there is reason for believing that it forms the foundation of all the highest

forms of attention. If it be lacking there is no means by which the behavior of the individual may be modified. Moreover, one is born with a certain capacity for attending. Difference in this native strength may have much to do with the difference in accomplishment of different individuals. For instance, according to some authorities that which makes the musician or artist or the mathematician is, among other causes, the difference in the character and intensity of his original attentiveness rather than the fact that he has inherited some specific ability directly.

3. Of the stimuli that cause sensations and attract attention, some produce a pleasant effect and some produce an unpleasant effect. There is a feeling of the one kind or the other accompanying most, if not all, sensations. Thus a bitter taste is naturally unpleasant, as any one can discover who will try to feed something bitter to a very young baby. The way in which, during the course of evolution, certain stimuli have come to produce these unpleasant conscious states is interesting to speculate upon but does not alter the facts. More interesting than the feelings is the behavior that accompanies or follows them. In the presence of unpleasant stimuli, one naturally responds so as to get rid of the unpleasantness, and the responses continue in varying form until this result is accomplished. This variety of responses which follows upon the receipt of unpleasant experiences in the effort to get rid of them, and upon pleasant ones in the effort to retain them, is an important factor in the adjustment processes of learning and remembering.

4. Of all the stimuli that affect the sense organs, are attended to, and cause a pleasant or unpleasant reaction, some leave a permanent effect and are remembered, whereas others are forgotten. This fact, like sensitiveness, is taken so much for granted that its importance escapes attention until some abnormality appears. Retentiveness depends upon a fundamental characteristic of the nervous system, its impressibility, which is not subject to improvement. Thus one's possibilities of memory are fixed by his heredity, although his actual accomplishments within this limit may depend upon education and other factors.

5. Finally, it should be noted that human beings have a natural tendency to be active both physically and mentally. The specific character of that activity may be, and usually is, determined by various factors in the environment, but the activity itself is the expression of a natural tendency. There is no such thing as laziness, strictly speaking. To refuse to be active is a symptom of defect or disease, lowered bodily tone, improper nourishment, or the like. Laziness, however, is not so much inactivity as activity in a wrong or useless direction, as judged by social or ethical standards.

UNLEARNED MODES OF BEHAVIOR

The bodily mechanism is so organized at birth, and even before, that certain simple forms of behavior will occur when particular stimuli affect the sense organs. A bright light falling into a newborn baby's eye will cause the pupil of the eye to contract; food placed in the mouth will cause acts of swallowing. These together with the acts of emptying the bowels and bladder and many other activities necessary for the preservation of life are known as reflexes. Some of them are so automatic in character as to be completely independent of consciousness, as in the case of the pupillary reflex. They are present in all normal persons and are seriously modified only when the neural mechanisms on which they depend break down, or when other exceptional conditions develop. One exceptional circumstance would be the conditioning such as Cason (*93*) first produced as a result of which the pupillary reaction, both constriction and dilation, became associated with new stimuli. Just how far changes of this sort can be carried is a matter of speculation at present (*686*).

Other reflexes, such as the salivary reflex and those associated with it in the process of alimentation, are subject to a degree of modification, although always relatively independent of conscious control. On account of their relative fixity they do not play an important part in the process of adjustment so long as they function normally. When, however, any abnormality develops in these reflexes, it may serve as a symptom of more severe behavior disturbances to come.

A more complicated behavior pattern occurs in response to a startling stimulus such as a sudden loud sound. Landis and Hunt (*358*) have analyzed this response by means of the high speed motion picture. The *startle pattern*, as it has been called, which occurs during the first half second following the stimulus, "is a complex, almost invariable, involuntary, innate reflex response clearly demonstrable under the temporal magnification of high or superspeed motion-picture photography." According to Landis and Hunt, it obeys all the laws governing reflexes. It is only slightly under voluntary control; it habituates to a certain degree and can be conditioned. "Yet it is a much more complicated response than the integrated spinal reflexes usually studied in animal preparations. Indeed, there is good evidence that this whole pattern is organized rather high in the midbrain." The point of most interest at the moment is the complicated nature of the response, taken together with the fact that it is unlearned, relatively invariable, and innate.

Although it may seem to be a small step from the startle reaction to emotional reactions such as fear, anger, and joy in contrast to the

apparently large step from a simple reflex to a startle pattern of reaction, evidence concerning emotional behavior is most conflicting. Those who have depended upon the direct observation of children for their evidence have reached conflicting conclusions about the innateness of the responses (*48*) (*562*). Judgments of the facial expression of adults either directly or in photographs for uniformity and identifiability of pattern as an indicator of innateness have also disagreed (*356*) (*361*).

The most recent attempt to resolve the disagreement has compared the facial reactions of blind and seeing children. Thompson (*612*) took motion pictures of twenty-six blind children while they were undergoing certain emotional reactions, and besides having the pictures judged for the emotions portrayed, she also analyzed the facial response to find which features took part in the reactions. She found the pattern of muscular activity underlying the laughing, smiling, and crying reactions of blind, deaf-blind, and seeing individuals to be approximately the same. The judges rated the reactions of the blind and seeing with an equal and a high degree of consistency and accuracy. Thompson concluded, on the basis of all her observations, that the "facial expressions of emotion do occur without learning." The least well-established case was that of fear, probably because the stimuli to fear reactions were very weak.

In the light of the very great difficulty of establishing the native or unlearned character of the behavior patterns thus far studied, it seems futile to attempt to do the same for the highly complicated patterns generally envisaged under the title of instincts. Such spatial and temporal chains of reaction as fighting, collecting things, and showing curiosity acquire their particular patterns from the immediate circumstances such as who or what is being fought, what is being collected and how, and to what the reactions of curiosity are directed. Nevertheless, the study of both animal and human subjects suggests that there is some kind of motivation or impulsion to act toward a certain end no matter how varied the pattern may be. It has seemed more fruitful to the applied psychologist within recent years to examine these impulses and look for uniformity within them rather than within the particular behavior manifestations.

NEEDS, WANTS, AND DESIRES

A rather sweeping statement is commonly made to the effect that all behavior is motivated. Young (*731*, 1) offers the following samples:

Getting out of bed when the alarm clock rings, brushing the teeth, shaving, selecting the day's necktie, ordering rolls and coffee or ham and eggs from the

menu card, picking up the paper to read the news—these everyday activities are all causally determined. You take them for granted, generally being unconscious of any motive determining what is being done. Nevertheless a definite motivation is invariably present.

Without critical inquiry at the moment into the universality of motivation, which, by the way, can be readily assured through an appropriate definition of the term, one can proceed to seek and find sources of human motivation in original nature.

There is a class of appetites or cravings which are definitely associated with the needs of the body tissues for foodstuffs, fluids, salts, and minerals. These cravings are said to motivate the organism to activity that is calculated to satisfy the deficiency, as in the case of wild deer that will travel many miles to find a salt lick. One finds the basis for these needs in a kind of organismic homeostasis (*502*) analogous to organ homeostasis so dramatically described by Cannon (*79*). He pictures control mechanisms within the human body by way of which temperature, acid-alkali balance, water content of cells, and other conditions are maintained within extremely narrow limits of variation. The organism as a whole seems to do likewise within its milieu.

Another group of needs and desires arises from pressures within the organism such as the distention of the lower bowel and the bladder which calls for certain responses that are usually taken care of early in life through the formation of habits of elimination. Another need with its accompanying desire is said to be associated with the distention of certain of the sex glands and leads to the act of emptying them. Still another need which originally rests upon a physiological condition and which gives rise to a desire is the condition designated by the name "fatigue," in which there is a desire for rest. Just what the condition is, whether it is a depletion of energy-producing materials, or the accumulation of waste products of some sort, or the disturbance of some kind of balance within the central nervous system is an unsettled question (Chapter 6). A desire for rest does follow prolonged activity, however much other factors such as habit or the sight of a comfortable bed may overlay the original need.

Over and above these few needs and desires which appear to grow out of some organic or organismic condition there is a long list which has no such tangible foundation. As one would expect in such a case, there are differences of opinion as to what desires should be treated as innate. Thorndike (*626*, 96-151), who catalogued twenty such desires and made practical use of them in the interpretation of social phenomena, was not greatly concerned about their innateness. For, he says, "...If more searching observation finds one of these to be a

product of some environmental condition, that environmental condition is likely to be itself fundamental and widespread," and "Even if the widespread occurrence of the want is due to a widespread occurrence of some environmental cause, it is useful to have emphasis upon such wants." The point that he makes is that for purposes of interpretation of social behavior it is the relative universality of the characteristic rather than the innateness that is important.

Some of these desires that are most likely to be acceptable to the majority of authorities are:

1. The desire for sensory stimulation, sights, sounds, tastes, odors, contacts, and the like
2. The desire for exploration and manipulation, covered perhaps by the term curiosity
3. The desire for approval
4. The desire to assert oneself or to dominate others
5. The desire to give and receive affection
6. The desire for comfort, security, and protection
7. The desire to be with others of one's own kind

There is no need to extend the list. It can be made many times as large by breaking down any one of these classes into more specific needs.

RELATIVE STRENGTH OF MOTIVES

This extremely brief sampling of the fundamental characteristics of human nature, of its unlearned modes of behavior, and of its needs and desires gives some notion of the raw material out of which child and adult behavior evolves. So much importance is attached to these urges because in most instances the specific means of satisfying them is not predetermined, with the consequence that the individual is open to a wide range of influences extending all the way from systematic education and specialized training to the machinations of the advertiser and even to the mere play of chance. The advertiser who puts up the largest and most brilliantly colored sign knows that other things being equal, it will attract attention away from its less vivid neighbors; a bed or a drug can be sold for its comfort-giving qualities; a life work may be chosen for its promise of security, or for the opportunity that it affords to be sociable or to dominate other persons; a laborer may be made to put forth more effort in order to earn the money to buy a better radio than his neighbor's.

Many efforts have been made to measure the relative strength of these drives, but it has not been easy to do and the results are frequently conflicting. So far as predicting the behavior of a given person is concerned, any set of measurements will be limited in their application on account of the large individual differences to be ex-

pected. Nevertheless, there is some real point in knowing what will be the relative strength of motives for people in the mass. Most work on this problem has been done with animals because of the ease with which conditions may be controlled, although the social urges of human beings that determine action and that are commonly played upon cannot be evaluated from the data obtained from animals. Measurement of the intensity of animal drives (*677*) in terms of the obstacles that an animal will surmount in order to satisfy them has furnished a clue for the measurement of human desires. For example, Thorndike has calculated the relative force of human desires in terms of the amount of time (*625*) that will be allotted to them or the amount of money (*633*) that will be spent to satisfy them. In the latter investigation he began with data on the amount spent by the people of the United States for such items as clothes, laundry, life insurance, death and burial, food, and shelter. He then had these objects of expenditure translated into needs by a group of judges. In this way the expenditures for clothing were roughly allotted to desire for protection, for pleasure, for sex life, for social approval, and for dominance. Other items were treated in a similar fashion. The data presented in Table 1 are the partial outcome of such com-

TABLE 1

RELATIVE STRENGTH OF HUMAN DESIRES *

Desires	*Percentage of Total Expenditure*
Hunger	11.2
Protection against the elements	10.2
Exercise	0.4
Rest and sleep	2.6
Sex relief	0.8
Reproduction	1.9
Protection against animals and disease	4.4
Protection against bad people	2.5
Minimizing pain	3.5
Taste and smell	4.6
Sight and sound	3.9
Sex entertainment	3.9
Security	10.5
Affection	1.8
Companionship	2.3
Approval of others	7.2
Approval of self	4.0
Mastery over others	3.0
Welfare of others	7.2
Mental activity	1.9
Curiosity and exploration	1.8
Social entertainment	4.2
Physical entertainment	1.1
Other comforts	4.5

* Adapted from E L Thorndike, "What Do We Spend Our Money For?" *Sci. Mo*, 1937, *45*, 226-232.

putation. It gives first the list of desires and then the percentages of the total expenditure allotted to the satisfaction of each desire. The percentages range from .4 per cent for exercise to 11.2 per cent to satisfy hunger. Inspection of the various items of the table will furnish some interesting and entertaining comparisons.

CAPACITY AND TEMPERAMENT

This brief sketch of native endowment cannot be concluded without some reference to the more generalized potentialities signified by the terms capacity and temperament. It is entirely possible that further research and keener insight may reduce these to peculiar patterns of the sensitivities, reactions, tendencies, and urges such as have been listed above. Until such analysis has been made, however, they must be granted a place in the scheme of original human nature. As the history of intelligence and personality research clearly shows, it is extremely difficult to identify what is native and what is acquired in these complex traits. Every measurable manifestation of them appears in some form of learned response, so that the isolation of what is native must be inferred from instances, natural or controlled, in which the contribution of nurture can be more or less accurately gauged. Further discussion of these matters will be found in later chapters devoted to the subjects of intelligence, special capacities, character, and interest where they will be treated in accordance with their significance for adjustment.

NATIVE RACIAL CHARACTERISTICS

It is to be expected that individuals will vary one from the other in the amount of these specific native endowments and some estimates have already been furnished as to the magnitude of the differences. A further question demands at least a tentative answer, if only to temper popular misconceptions with facts in so far as they have been scientifically determined. This question concerns the possible unique endowment of certain groups such as races, nationalities, and the sexes. Does one racial group, one nationality, one sex differ significantly from another in behavior pattern, and does such difference rest upon fundamental native differences?

One hears much nowadays about hereditary racial differences—that the Germans represent a race with certain characteristics, the French with others, the English with others—with practically no attempt to separate the facts of inheritance from the effects of education, customs, and general environmental conditions. Furthermore, there is

little or no regard for the great admixture of racial stocks, with the result that nationality differences tend to be accepted as the equivalent of racial differences.

The first experimental studies were made upon rather simple functions such as sensory acuity, motor ability (speed of reaction, and speed of tapping), and simple judgments (such as the form-board test). Although these traits are simple, yet they are characteristics in which peoples are supposed in the popular mind to differ. For instance, certain races are thought to have remarkably keen vision; some are said to be very slow, others very quick in their reactions. The upshot of all experimental tests seems to be that the racial differences in fundamental qualities independent of training are slight. There is in every case, even in sensory acuity and speed of reaction, much variability among the members of the same race, so that in the race making the best records there are always some individuals who do as poorly as some of the best individuals in the poorer races. Woodworth (*716*, 171), in discussing the results of the form-board test, which is a fair test of intelligence and little dependent on specific training, says:

As between whites, Eskimos, Ainus, Filipinos, and Singalese, the average differences were small and much overlapping occurred. As between these groups, however, and the Igorot and Negrito from the Philippines and a few reputed Pigmies from the Congo, the average differences were great and the overlapping was small.... If the results could be taken at their face value they would indicate differences of intelligence between races, giving such races as the Pigmy and Negrito a low station as compared with that of most mankind. The fairness of the test is, however, not beyond question; it may have been of a more unfamiliar sort to these wild hunting folk than to the more settled groups. This crumb is, at any rate, about all the testing psychologist has yet to offer on the question of racial differences in intelligence.

When one grasps the full meaning of this statement, namely, that between the highest and the lowest races there are no differences which have up to this time been positively established, it is scarcely to be expected that differences of any importance would be found among the higher races. This statement of Woodworth concerning his samples of specific racial groups is confirmed and extended by Boas (*50*) who reaches his conclusion after surveying the whole body of evidence concerning primitive man.

Since the study of Woodworth, interest has been increasingly directed to the measurement of intelligence differences, although special characteristics (*199*) have attracted attention from time to time such as color preferences, tempo of movement (*176*), speed and accuracy of movement, fatigability, emotional control, speed of learning, and musical talent. The evaluation of racial differences in intelligence

has offered peculiarly serious difficulties. First and foremost among these has been the inability to isolate pure racial stocks for measurement. This difficulty has been especially acute in the comparison of Negroes and whites in the United States, the topic of so many researches during the last two decades. Not only is the ancestry of the living generations of Negroes mixed to an unknown degree, but the degree of admixture of white blood has seemed to alter intelligence-test scores (*168*).

A second serious difficulty resides in the fact that no universal intelligence test has been nor probably will be devised. Moreover, any legitimate comparison of races requires that allowances be made for differing selections within the racial groups; for differences in motivation to perform the test; for differences in facility with language and other abstract symbols that the test employs; for cultural differences which may affect the attitude toward the test; for differences in schooling, in economic and social status; and finally for differences in the degree of rapport which the examiner succeeds in establishing with his subjects. By the time corrections are applied to the original scores for all these variables, the investigator may well wonder at their significance. These technical problems in measurement are well illustrated in the study by Klineberg (*345*) of differences in Negro intelligence wherein he attempts to analyze the presumption of a factor of selection created by the differential migration of Negroes from town to city and from south to north. This is only one of the many secondary problems that demand solution before the main question of intelligence differences between Negroes and whites in the United States can be definitely settled.

Klineberg (*346*), after surveying the evidence for racial differences, casting aside all subjective estimates of such differences, and relying upon the best measures available to natural and social science, concludes that "the case for psychological race differences has never been proved."

RACIAL DIFFERENCES IN TEMPERAMENT AND EMOTION

The casual observation of racial differences would lead to the expectation of greater differences in temperament, emotional attitudes, and general excitability than in intelligence. Such popular notions are, however, difficult to verify at present because suitable tests for the purpose are not available. Differences in excitability might be measured by means of the psychogalvanometer technique but such an investigation has not been reported. An attempt has been made to measure

temperamental differences by means of the Will-Temperament Test of Downey. In such a project there are added to the problems of selection those arising from the use of a measuring instrument the value of which has not been definitely proved. The differences that have been found are small and not well established. The nature of the findings is illustrated in the following paragraph from McFadden and Dashiell (*412*):

> In predominance of temperamental patterns, the whites slightly surpass the Negroes in the number of mobile, rapid-fire individuals; they have a clear superiority in the number of controlled, deliberate, careful persons; and they slightly surpass the Negroes in the number of individuals showing a combination of these two characteristics. The Negroes slightly surpass the whites in the number of aggressive persons and in the number of individuals combining quickness and mobility with aggressiveness, and also in the number of individuals combining aggressiveness and deliberation.

The experiment of Crane (*119*) represents a unique attempt to discover non-intelligence differences between whites and Negroes. Taking as a starting point the commonly observed differences in such characteristics as impulsiveness and improvidence, he argued that the differences might be due to greater strength of impulses in the Negro, inferior mentality preventing foresight as a basis for control of behavior, or a lack of inhibitory power in the regulation of behavior. He then conducted tests upon 100 whites and 100 Negroes which were calculated to measure these three characteristics. Grade of mentality was measured by means of an individual intelligence examination. The strength of impulses (fear was chosen as a sample) was measured by the withdrawal of the hand from the path of a falling weight. Inhibitory power was measured by the inhibition of the withdrawing movement, accompanied by twitching or "flinching" of the muscles involved in the withdrawal movement and by disturbances of the breathing. He found among the white subjects fewer withdrawals of the hand, but a greater *tendency* to withdraw it as indicated by muscle twitch and breathing. He concluded that the behavior differences between the two races were due not so much to intelligence or strength of impulses as to differences in the power of inhibition.

The survey of the literature upon race differences, only a sampling of which is given in this chapter, leads to the conclusion that, in the simpler functions at least, the likenesses are more striking than the differences. Greater differences are found when "higher" intellectual traits and temperamental characteristics are measured, but these are materially reduced when needed corrections are made. From the point of view of applied psychology, the probability is that it will always be more effective to select for any given purpose the superior individual

regardless of race than to choose one because he is a member of a given race. The differences among persons of a given race are likely to be many times greater than the average difference between races as a whole.

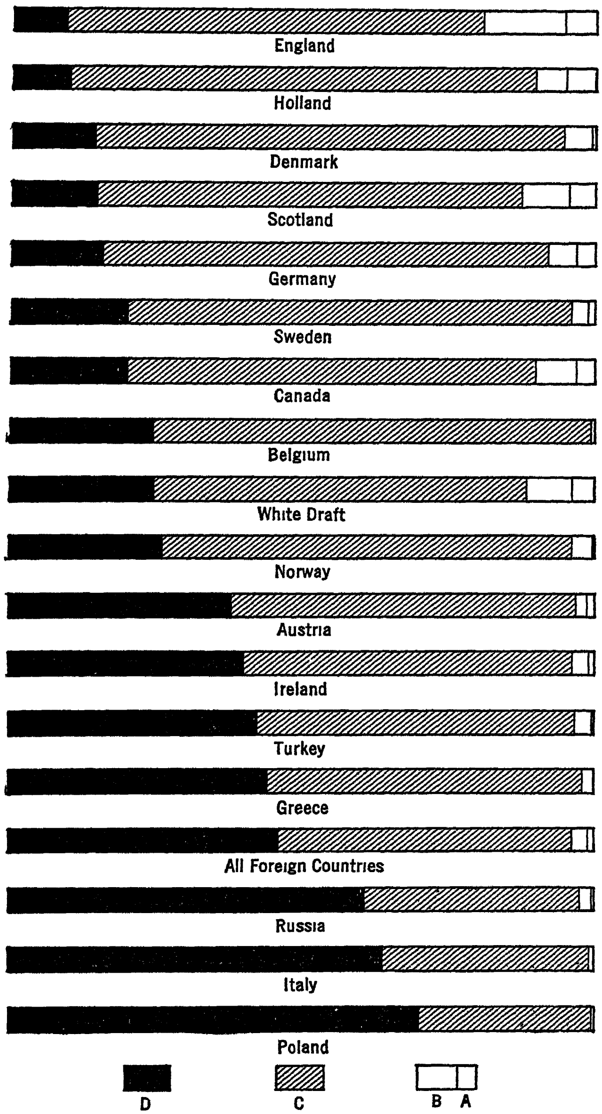
NATIONALITY DIFFERENCES IN INTELLIGENCE

A problem closely related to the one just discussed has to do with nationality differences (*347*) and particularly those differences that exist among the various nationality groups in the United States. A large body of data concerning the relation between intelligence and nationality has been supplied from the records of the psychological examinations in the United States Army (*729*). An intelligence examination, in one or other of its forms, was administered to natives of sixteen foreign countries in numbers sufficiently large to make conclusions from them fairly reliable. Figure 2 shows the distribution of scores among the representatives of these nations. The records are in terms of the letter grades *A*, *B*, *C*, and *D*, in which *A* stands for the highest grade of intelligence and *D* for the lowest, and which are designated as shown at the bottom of the chart.

The range of differences among the countries is a very wide one. Whereas 8.7 per cent of the men from England made a grade of *D* or less, almost 70 per cent of the Poles were found in these low grades. The Scandinavian and English-speaking countries show relatively high scores, whereas the Slavic and Latin countries show low scores. The intelligence ratings of these foreign groups cannot be taken as an indication of the level of intelligence of the countries from which they came. There have been, among other factors to be considered, differing forces at work in the various countries tending to control the character of emigration. There is also the possibility that the Army intelligence tests (Alpha or Beta) do not give equal opportunity to all racial groups to show their native capacity. But it is significant that within the population of the United States the foreign groups did differ so much, whatever the cause of these differences may be. The results of the tests show, at least, the varying difficulty that representatives of different countries meet in adapting themselves to the environment offered by the United States. A further analysis of the scores for foreign-born groups suggests that adaptation to the test conditions does take place. When the foreign born are grouped according to years of residence in the United States, a regular increase in the scores occurs with each added five years of residence. This increase, in terms of mental age, amounts to more than two years for residence periods ranging from five years or less to twenty years or more. It is well to recognize that some doubt exists as to the correct

FIGURE 2

DISTRIBUTION OF INTELLIGENCE-TEST SCORES AMONG NATIONALITY GROUPS *



* From R M Yerkes, editor, "Psychological Examining in the United States Army," *Mem. Nat Acad Sci*, 1921, *15*, 697.

interpretation of this change of intelligence score with length of residence, as indicated in the following statement by Yerkes (*729*, 704):

> Apparently then the group that has been longer resident in this country does somewhat better in intelligence examination. It is not possible to state whether the difference is caused by the better adaptation of the more thoroughly Americanized group to the situation of the examination or whether some other factor is operative. It might be, for instance, that the more intelligent immigrants succeed and therefore remain in this country, but this suggestion is weakened by the fact that so many successful immigrants do return to Europe. At best we can but leave for future decision the question as to whether the differences represent a real difference of intelligence or an artifact of the method of examination.

The bearing of these findings upon the question of the control of immigration has already received considerable attention. Equally important psychological problems arise in connection with the adjustment of our educational and industrial systems to meet the demands imposed upon them by these varying foreign groups (*59*).

NATIVE SEX DIFFERENCES

In the early part of the present century research upon sex differences had as a background a strong tradition to the effect that the sexes were by nature very different. The tradition has been sufficiently strong to create widely divergent life careers for the two sexes. Moreover, it has been strong enough to lead the early investigators to seek significance in the very slight score differences which mental tests revealed. The first World War noticeably weakened the tradition of sex differences. In the war years one grew accustomed to hearing about and seeing women taxi drivers, streetcar conductors, and farm and industrial workers. And they seemed to be efficient in these tasks. In the intervening years there has been a steady increase in the number of women gainfully employed in business and industry, with the result that a new emergency finds women ready and able to replace men in any kind of occupation.

The same problems are met in isolating sex differences in behavior as were encountered in the study of racial and nationality differences. In order to study nature as the variable, environmental factors must be controlled. It is not possible to draw safe conclusions from the everyday achievements of men and women. Women who work in industry, for instance, may be handicapped by the tradition that they and not men should do the housework after the day in the factory, with the result that their working days are longer. The statistical studies of the relative numbers of successful men and women in the professions and the arts may likewise be misleading because the

traditions of the proper work for women still affect the status of the generations of women up to and including the present. Scientific measurement must provide the answer.

PHYSICAL AND PHYSIOLOGICAL DIFFERENCES BETWEEN THE SEXES

The question of sex differences can best be handled by considering, first, the physical and physiological characteristics of the sexes and then the mental characteristics. Physically, women have a smaller average size and weight of the body as a whole, and of parts such as the skull and trunk. Men tend to be stronger than women and more so than the difference in bodily size and weight would warrant. The difference is to be attributed at least partly to intrinsically stronger muscles, rather than to differences in their development. The most striking difference in structure and functions, however, is in what are called the primary sex characters (*157*). Thus the anatomy and the physiological mechanisms of women are adapted to the bearing and the rearing of children, whether they ever have them or not. In connection with this primary sex function, all females have been thought to be handicapped by their periodical functions, which incapacitate them both physically and mentally for a certain time each month, and on this account women have been considered as excluded from many of the professions and occupations open to men. The same argument has many times been used against coeducation. A certain amount of physical disability may be granted. But careful experimental study (*283*) (*550*) of mental and motor ability over long periods of time has failed to show any rhythmic variation in ability or performance, and has tended to refute the older views as inapplicable to normal healthy women.

SEX DIFFERENCES IN INTELLECTUAL FUNCTIONS

Thorndike (*622*, Vol. III, 182-183) collected evidence concerning sex differences in intellectual functions from a great variety of sources and expressed the results uniformly in terms of the percentage of males who are as good as or better than one half of the females. (The percentage of the males who equal or excel the median of the females.) Some of his data are reproduced in Table 2, which shows that only 24 per cent of men do as well or better than half of the women in the naming of colors and the sorting of cards, whereas 71 per cent of the men equal or exceed the women in speed of arm and finger movements.

TABLE 2

SEX DIFFERENCES IN INTELLECTUAL FUNCTIONS *

Name of Test	Percentage of Men Reaching Median of Women
1. Color naming and card sorting	24
2. Cancellation tests	33
3. Spelling	33
4 English (school marks)	35
5. Foreign languages (school marks)	40
6. Immediate memory	42
7 Sensory threshold	43
8. Retentiveness	47
9. Association (speed and accuracy)	48
10 General information	50
11. Mathematics (school marks)	50
12. School marks (average of all studies)	50
13 Discrimination (other than color)	51
14 Range of sensitivity	52
15 History (school marks)	55
16. Ingenuity (special tests)	63
17. Accuracy of movement (of arm)	66
18. Physics and chemistry (school marks)	68
19. Reaction time	70
20 Speed of movement (finger and arm)	71

* Adapted from E L. Thorndike, *Educational Psychology* (New York, Teachers College, Columbia University, 1914), Vol 3, pp 182-183.

These records are collected from various sources and represent different degrees of reliability. The twenty traits may be roughly divided into three groups, namely, those traits in which women excel (1 to 7); those traits in which the sexes are equal (8 to 14); and those traits in which men excel (15 to 20). An examination of these three groups may give some grounds for belief in certain differences generally attributed to the sexes. For instance, women appear to be better in language work and men in science work; women rank higher in sensitivity and men in activity. But the overlapping of the sexes in these traits is just as significant as the differences. And, further, one cannot exclude the possibility that these differences, such as they are, may have other than a hereditary basis.

FIGURE 3

OVERLAPPING OF SEXES IN COLOR NAMING

Solid line males
Broken line females
Shaded area common to the two sexes

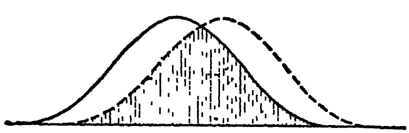


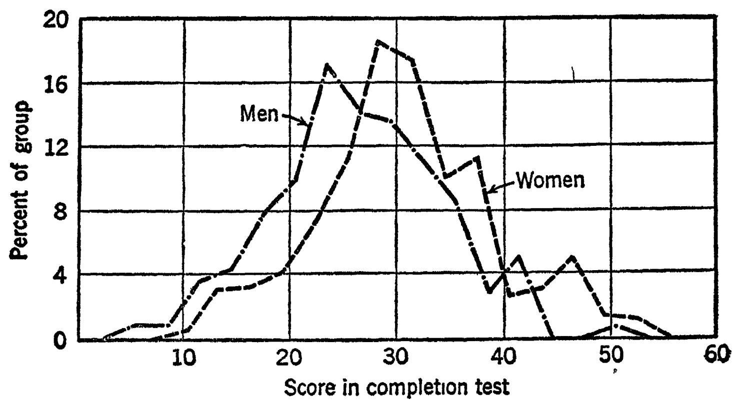
Figure 3 shows roughly the amount of overlapping that would occur between males and females in the case of the sex differences in the naming of colors where only 24 per cent of the males equaled or exceeded the females, assuming that the distribution of the func-

tion is a normal one. The solid line would represent the males and the broken line the females. The shaded portion of the chart shows the proportion of the two sexes that would have equivalent scores.

A great mass of material has accumulated from the widespread use of the intelligence tests in schools and colleges, and from it sex differences may be computed (*68*) (*607*, Vol. I) (*609*, 68). In children of various ages up to and including the fourteenth year, the females exceed the males by a few points of IQ (Intelligence Quotient). This is paralleled by the increased rate at which female children mature physiologically. The difference, however, disappears entirely when the two sexes reach adult age. Hence, it has no particular significance

FIGURE 4

SEX DIFFERENCES IN THE COMPLETION TEST*



* From R S Woodworth, *Psychology*, 4th ed (New York, Henry Holt and Co, 1940), p. 86

so far as the life achievement of the sexes is concerned. Terman, in his study of about 1,500 gifted children (minimum IQ 132) found a larger proportion of boys than of girls in the group, the lowest ratio being 120 boys to 100 girls. A careful examination of his methods of selecting the gifted children failed to reveal any bias working in favor of the boys, either in the original nomination of the cases or in their examination by the Stanford-Binet test. The ratio is, therefore, accepted by him as a genuine picture of the sex differences among highly gifted children. No entirely satisfactory explanation of the facts is offered.

Woodworth (*715*, 85) gives data for a series of tests for intellectual functions administered to 259 college women and 141 college men. Figure 4 gives the data in graphic form for a Completion test, which is the one showing the largest sex differences. As Woodworth says:

"The individuals within each sex differ among themselves so much as to make the difference between the sexes of small consequence. Such is the result in practically every instance of sex differences in mental ability."

SEX DIFFERENCES IN VARIABILITY

When the early tests failed to show differences in capacity sufficient to account for the discrepancies between the sexes in achievement, other explanations were sought. One of these is a difference of variability within the two groups, which, if found to be the case, would be a very vital difference. For instance, if men were found to be the more variable sex, in the sense that men covered a greater range of performance, then the best and the worst human beings would be men, and the fact that men have figured more prominently in the deeds of the world would be accounted for in the original constitution of the sexes. Likewise, if this were true, the highest achievement in the future could be expected from men.

A rather common opinion among scientific men has been that men *are* more variable than women in this sense. The view was first contested by Karl Pearson (*491*) and since that time the earlier studies have been examined more critically and much evidence has accumulated which casts doubt on claims of differences in variability between the sexes. When unfavorable environmental conditions are allowed for, and sufficiently large numbers of individuals are tested, the differences in variability decrease.

One of the most persistent arguments for a sex difference in variability rested upon the proportion of feeble-minded in the two sexes. Studies made in institutions for the feeble-minded and defective show at first glance that there are more men than women admitted to these institutions. Since this is just what should be expected if men were more variable than women—men being both better and worse than women—the data have been used in support of the contention that men are more variable than women. But a closer study of the significance of the figures, together with consideration of the forces that bring cases to institutions for the defective, shows that the two sexes are affected unequally by these forces (*282*) (*287*). Defective women are much more likely to be maintained outside of institutions than men, because they are essentially a dependent and non-competitive class, hence do not succumb in the economic struggle. As far as range of variability of the two sexes is concerned, the above arguments give no good grounds for assuming a difference.

McNemar and Terman (*420*) have reopened the whole question of sex variability and have subjected various collections of data to a

critical analysis. From the evidence given by standardized tests of intelligence, they find a consistent trend in the direction of a greater variability in males. The amount of this difference is great enough to produce nine boys to every six girls with an IQ score above 140, or below 60, and twice as many boys as girls above an IQ of 160 or below 40. From these data it would appear that in the long run there should be more exceptionally great men than women, and more exceptionally stupid men than women, but between these extremes the populations could be equivalent.

NON-INTELLECTUAL DIFFERENCES

Men and women may be said to differ in ways not measured by these mental tests, as in emotionality, impulsiveness, and sympathy. Standardized tests are not available for the measurement of such characteristics, and the results that have been reported from time to time are based upon the controlled judgments of the two sexes by friends, teachers, relatives, and acquaintances. Such measures are subject to inaccuracies (Chapter 13) but still give a more reliable picture of sex differences than the more casual impressions or prejudices that usually form the basis of opinion.

In practically all of these characteristics, as in the groups of traits previously described, there is a great overlapping of the two sexes. It is likely also that some of the differences that are shown may be due to the different standards in the traits which custom decrees for men and women; that is, the differences may be due to environmental rather than to hereditary factors.

One other characteristic mentioned by Leuba (*374*) would seem worth investigating, namely, the energy available for productive living. As he points out, a high intellect may go to waste unless its possessor can employ it, and of two persons equally endowed intellectually that one who has the greatest endurance will, other things being equal, become the more outstanding individual. Data on this characteristic are not available.

It is possible that research into the functions of the internal secretory organs and their relation to personality traits may reveal sex differences that have not yet been measured, and that will account in part for the popular notion of the ways in which the sexes differ. It is already known that the complex endocrine mechanisms are intimately bound up with the development, activity, and decline of the sex functions. The primary sexual characters may be correlated with glandular activities which at the same time may make the sexes differ in such mental manifestations as emotion and temperament.

From the strictly practical point of view and in the light of present established facts, the matter is aptly summarized in the following statement of Thorndike (*621*, 345):

> The most important characteristic of these differences is their small amount. The individual differences within one sex so enormously outweigh the differences between the sexes in these intellectual and semi-intellectual traits that for practical purposes the sex differences may be disregarded. So far as ability goes, there could hardly be a stupider way to get two groups, alike within each group but differing between the groups, than to take the two sexes. As is well known, the experiments of the past generation in educating women have shown their equal competence in school work of elementary, secondary, and collegiate grade The present generation's experience is showing the same fact for professional education and business service. The psychologist's measurements lead to the conclusion that this equality of achievement comes from an equality of natural gifts, not from an overstraining of the lesser talents of women.

THE INFLUENCE OF FAMILY INHERITANCE UPON ADJUSTMENT

In addition to the original nature common to the human species as a whole, to the specific race to which one belongs, and to a given sex, does an individual possess certain traits by virtue of having a certain immediate ancestry—parents, grandparents, great-grandparents? The influence of ancestry upon a number of physical characteristics such as eye and hair color and height has been worked out (*112*). Mental resemblances are not so definitely determined, but those which have been found, supported by the certainty of physical inheritance, lead us to expect that one's immediate ancestry is of considerable importance in determining what his mental qualities shall be.

THE INHERITANCE OF PHYSICAL TRAITS

It should not be expected that, if heredity is a real factor, two persons of the same ancestory should have original natures which are identical in every respect, except as different environments changed them. This may be easily proved by taking physical characters which cannot be affected by environment, such as the color of the eyes. The relationship between brothers in eye color expressed as a coefficient of correlation has been found to be only +.52.

Height may be taken as another illustration. Children of parents who are three inches above the average in height will average only about two inches above the average; that is, they will not be identical in height with their parents but will tend toward the average of the

whole race. Thorndike (*622*, Vol. III, *227*) describes the reason for these variations as follows:

In all thought of inheritance, physical or mental, one should always remember that children spring, not from their parents' bodies and minds, but from the germs of those parents. The qualities of the germs of a man are what we should know in order to prophesy directly the traits of his children. One quality these germs surely possess. They are variable. Discarding syntax and elegance for emphasis, we may say that the germs of a six-foot man include some six-foot germs, some six-foot-one germs, some six-foot-two germs, some five-foot-eleven, some five-foot-ten, etc. Each human being gives to the future, not himself, but a variable group of germs. This hypothesis of the variability of the germs explains the fact that short parents may have tall sons, gifted parents stupid sons, the same parents unlike sons.

Other well-established relations between relatives in regard to physical traits are:

Trait	*Individuals*	*Correlation*
Height	Father and son	+.30
Height	Brother and brother	+.50
Cephalic index	Brother and brother	+.50
Hair color	Brother and brother	+.60

These figures show very clearly that one owes his physical characteristics to a certain extent to his immediate ancestry.

Consider next a characteristic that comes a little nearer to being mental, namely, deafness. It has been found from statistical studies that out of every four persons who have one brother or sister congenitally deaf, *one* is deaf, whereas of those persons who have neither brothers nor sisters born deaf, only one out of a thousand is deaf. This means that if one is of the same immediate ancestry as a person congenitally deaf, he is about two hundred and fifty times more likely to be deaf than a person who is of the same ancestry as a person with normal hearing.

THE INHERITANCE OF INTELLIGENCE

The question of the inheritance of intellect, always of vital interest, has attracted an ever increasing amount of attention with the development of standardized measures of intelligence, and with the growing acceptance of the intelligence quotient as a relatively fixed quantity. The earlier studies of inheritance of mental traits, beginning with that of Galton (*196*), were based upon the achievements of related individuals and upon estimates of their ability. These studies tended to magnify the importance of heredity, as there was no valid means of discounting the effects of environmental influences. Galton

found, among his 977 eminent men, over 300 times as many eminent relatives—fathers, brothers, and sons—as would be expected from the same number of average men. This finding, he believed, could not be attributed to the quality of training derived from membership in the eminent families. Likewise, the study of the heredity of about 700 royal personages led Woods (*708*) to attribute their attainments largely to heredity.

The more recent statistical study of eminent men and their families by Cattell (*97*) is especially interesting. He found the occupations of fathers of 885 noted men of science to be as shown in Table 3. The census of 1850, which represents about the period when the generation he studied was born, showed that, of the white population of

TABLE 3

Parentage of Eminent Men *

	Number	*Per Cent*	*Number*	*Per Cent*
Professional classes			381	43.0
Clergymen	89	10.1		
Physicians	66	7.5		
Lawyers	58	6.6		
Teachers	74	8.3		
Others	94	10.6		
Agriculture			188	21.2
Manufacture and trade			316	35.7

* From J. McK. Cattell, *American Men of Science*, Third Edition (New York, Science Press, 1921), p. 783

the United States, the professions comprised only 3.1 per cent, agriculture 44.1 per cent, and manufacture and trade 34.1 per cent. Thus it appears that the professions, which comprise 3.1 per cent of the population, produced 43 per cent of the scientific men of the country, whereas manufacture, trade, and agriculture, comprising 78.2 per cent of the population, produced the remaining 57 per cent.

Working over the same data, Brimhall (*60*) found the frequency of eminence among near and remote relatives of 1,000 eminent men. His results show that a distinguished man of science is about seventy-five times as likely to have a distinguished brother as is a man from the generality, and about seventy times as likely to have a distinguished sister as is a man from the generality. He found, further, that the likelihood of distinction decreases with the remoteness of relationship to the distinguished individual.

The conclusion of Cattell (*97*) will apply to both these studies. He sees in the figures the combined influence of inheritance and oppor-

tunity, represented by family influence and tradition, geographical location, and so forth. Concerning the relative potency of heredity and environment he says:

We may conclude that more than one half of our men of science come from the 1 per cent of the population most favorably situated to produce them. The son of a successful professional man is fifty times as likely to become a leading scientific man as a boy taken at random from the community ... A boy is fifty times as likely to do scientific work as a girl. No Negro in this country has, hitherto, accomplished scientific work entitling him to be included among our leading thousand scientific men. A boy from the professional classes in New England has a million chances to become a scientific leader as compared with one chance for a Negro girl from the cotton fields.

These great differences may properly be attributed in part to natural capacity and in part to opportunity. When it is asked how far the result is due to each of these factors, the question is in a sense ambiguous. It is like asking whether the extension of a spiral spring is due to the spring or to the force applied. Some springs cannot be extended a foot by any force; no spring can be extended without force.

One of the pioneer studies of mental heredity by means of psychological tests was made by Thorndike (629) in his *Measurement of Twins*. He used a variety of simple mental tests upon fifty pairs of twins and found an average correlation between them of +.80, as compared with a correlation of +.40 for brothers and sisters, with a correlation among unrelated children taken as zero. His figures were confirmed by Merriman (*425*) who found between all twin pairs a correlation of +.78, when measured with the Stanford-Binet examination. When the twins were classified into like-sex pairs and unlike-sex pairs, the correlation for the former was +.87 and for the latter was +.50. That is, the unlike pairs approach siblings in their degree of resemblance, whereas the like-sex pairs approach a perfect correlation. Genetically speaking, it is believed that unlike-sex twins do not differ from ordinary brothers and sisters, and this is confirmed by the results of the tests.

More recent researches have attempted to tease out the relative effects of heredity and environment by comparisons among singly born, unlike-sex twins, like sex non-twin brothers or sisters, and identical twins, where the environment can be controlled. The possibilities are thus stated by Woodworth (*712*, 5):

If the intra-pair difference is greater for the singly born than for fraternals, the cause must be sought in the environment, prenatal as well as post-natal. If the intra-pair difference is greater for unlike-sex than for same-sex fraternals, the difference may be due either to the genes or to post-natal environment. If the intra-pair difference is greater for the same-sex fraternals than for identicals, the fundamental cause must be sought in heredity.... Any intra-pair difference between identical twins must in general be due to some environmental factor.

With such combinations to study and with the facilities to provide for them differing or uniform environments (as by rearing identical twins apart or bringing unrelated children into the same environment), the problem of heredity *vs.* environment would seem to be ripe for final solution by these means. This desirable end is not in sight. At present the matter is so controversial and the conflicting data are so difficult to interpret that the student of applied psychology is justified in limiting his examination of the evidence to such a critical survey as that of Woodworth just quoted or going beyond it only to satisfy his personal interests.

Meanwhile, less accurate and less rigidly controlled procedures are accumulating evidence which seems on the whole to emphasize the influence of heredity in successful living. Terman (*607,* Vol. I, 3-5) (*611*), in a study of the mental and physical traits of 1,000 gifted children, classified their parents according to their occupation. The results which are shown in Table 4 furnish valuable support for the data of Cattell given on page 38. Whereas Cattell measured adults

TABLE 4

PARENTAGE OF GIFTED CHILDREN *

		Percentage of Fathers
Professional		31.4
Semi-professional and business		50.0
Higher group	31.2	
Lower group	18.8	
Skilled labor		11.8
Semi-skilled to slightly skilled		6.6
Common labor		0 13

* From L. M. Terman, *Genetic Studies of Genius* (Stanford University, Cal., Stanford University Press, 1925), Vol. I, p. 64.

in terms of achievements from which the influence of environment could not readily be disentangled, Terman measured the intelligence-test performance of children too young to be affected by such differences in environment as might later be operative. An examination of a number of environmental factors such as financial status of parents, home conditions, and residence neighborhood revealed no differences sufficient to account for the intelligence differences. Terman believes, therefore, that these children are gifted by original nature, and are not merely the product of a favorable environment.

Terman adopted another way of showing the intellectual status of the parents of the gifted children, namely, transmuting occupational status into intelligence status by means of the Barr scale of occupational intelligence. These figures may then be compared with the same kind of rating of adults of the generality, when allowance has been

made for the frequency of the different occupational groups. Table 5 gives these data. The first column gives the Barr rating, the second gives the percentage of the fathers of the gifted children attaining a certain rating, and the third column gives the percentage of adults of the generality reaching a certain rating. It would appear from this comparison that the parents of the gifted children are as highly selected for intelligence as are the children themselves.

TABLE 5

PARENTS OF GIFTED CHILDREN VERSUS THE GENERALITY *

Barr Rating	*Percentage of Fathers of Gifted*	*Percentage of Adults of Generality*
15 or above	26 8	2 2
12 to 15	26 8	4.5
9 to 12	36 1	37 0
6 to 9	8 9	13.4
3 to 6	1 3	42 9

* From L. M Terman, *Genetic Studies of Genius* (Stanford University, Cal, Stanford University Press, 1925), Vol I, p. 72.

THE CONTROL OF INHERITANCE

Argument for the control of inheritance rests in part upon such evidence for the transmission of intellectual qualities as has just been briefly sketched. It is supported by a great mass of evidence on the specific question of the inheritance of feeble-mindedness (*651*) and upon the inheritance of specific mental and physical defects and diseases (*359*) (*475*). The facts concerning the inheritance of special forms of delinquency are too little known at present to serve as a sure foundation for radical means of controlling inheritance.

The means of control now advocated in a thoroughgoing eugenics program are the limitation of marriage to those who can show a clean bill of physical health and present evidence of a normal mentality; segregation of the unfit in institutions where procreation of offspring can be prevented; birth control in the case of persons intelligent and coöperative enough to be willing to reduce hereditary defect; and sterilization either voluntary or made compulsory by the State (*301*). More difficult to control are the carriers of some hereditary disease who are themselves normal. The only recourse in such cases is dependence upon intelligent action where hereditary conditions are found in the ancestry and where the presumption is in the direction of their transmission. These proposals take no account of those persons who look upon feeble-mindedness as a consequence of ill-adapted environ-

ments and remediable through control of the environment, and it should not take account of them in the present state of knowledge. It is, doubtless, justifiable to proceed slowly in such matters, for we are constantly reminded that many of the great personages of history were defective in one or other of the ways mentioned in the preceding pages. But there is no doubt that the pressing character of the problem of deficiency will cause an accelerating limitation of production of possible burdens and menaces to society.

The promotion of measures for the prevention of the birth of undesirable individuals should not detract from the more positive and equally important function of preserving and multiplying the fit individuals. A sound eugenics program must include both means of improving the human stock. The delayed marriage of college-trained people and the decreasing birth-rate among the more intelligent portion of the population are only two of the problems that are attracting increasing attention because of their serious social consequences. The suggested remedies have varied from the reduction of the time required to qualify for the professions and for earning a livelihood, to the subsidizing of the fit with government funds. In any case the development of an adequate eugenics program will be a gradual process although its results will be cumulative. Appropriate action of the more intelligent portion of the population should be the first step in inaugurating it (*626*, 442-459).

3

Age and Adjustment

The human life-cycle has long attracted the thought and research of psychologists and scientists in related fields but with varying emphasis upon its several stages. The adolescent period was the first to be systematically studied, primarily because its apparently sudden and profound changes in behavior constituted an educational problem that could not escape attention (*236*). Early childhood next came in for scientific study with the increasing recognition of the importance of the early formative years for later development of the personality, with the discoveries that followed the application of the conditioned reflex techniques to very young children, and with the trend toward pushing formal education back into the very early years, via the kindergarten and the pre-kindergarten (*321*). Only within comparatively recent years has interest been directed toward the problems of maturity and late maturity. Both popular and scientific interest in the later years of life has now become genuinely aroused for several reasons. Perhaps the most important of these grows out of the increasing age of the population at large due both to the declining birth-rate and to the falling mortality rate during maturity. It has been estimated that whereas the 1930 Census shows 5.4 per cent of the population of the United States to be 65 years of age or older, by 1980 this age group will constitute 14.3 per cent of the population. The estimate is derived from data such as those of Table 6

TABLE 6

CHANGING AGE DISTRIBUTION IN THE UNITED STATES *

Age Group	*1930*	*1920*	*1910*	*1900*	*1890*	*1880*	*1870*	*1860*	*1850*
Under 5 years	9.3	10 9	11.6	12.1	12.2	13.8	14.3	15.4	15.1
5 to 19 years	29.5	29.8	30.4	32.2	33.8	34.3	35.4	35.8	37.4
Under 19 years.....	38 8	40.7	42 0	44.3	46 0	48.1	49 7	51.2	52.5
60 to 79 years	7.8	6.9	6 2	6.0	5 6	5 2	4.7	3.9	3.7

* From W R. Miles, "Age in Human Society," *Handbook of Social Psychology* (Worcester, Mass, Clark University Press, 1935), p 608.

compiled by Miles (*428*, 608) from United States Census reports and shows dramatically the shift in age distribution that has occurred from 1850 to 1930.

There is much speculation concerning the effects of such an age shift upon health, education, work, recreation, and ideas of the population. The importance of the age problem has been increased by the supposed and probably real stepping-up of the industrial tempo so that the less agile and less flexible workers are likely to fall by the wayside and constitute a serious social burden. The depression years with their over-supply of labor have temporarily exaggerated this condition through a tendency to discard older workers in favor of younger ones.

The popular economic and legal conceptions of capacity associated with age do not rest upon established fact in most instances. Why is the legal age of maturity set at 21 years, the minimal age for a President of the United States at 35, for a United States Senator at 30, and for a Representative at 25? Why was an individual over 28 years thought to be too unadjustable for present-day military service? Why is 18 years the upper limit for the employment of messenger boys, and 35 years for the employment of clerical workers and railway employees? Why are Supreme Court Justices eligible for retirement at the age of 70, college and university professors at 65 to 70? Why should one have to be 18 years old to be a licensed automobile driver, or 16 to be a licensed motor-cycle driver, or 18 to become a policeman? No scientific evidence answers these questions.

There are many signs of growing interest in the problems of aging in the publication of books (*117*), the holding of scientific symposia (*367*), and the organization of institutions for the study of age changes. The National Institute of Health of the United States Public Health Service in 1940 organized a new unit for research on the problems of aging and at the same time set up a National Advisory Committee on Gerontology (*586*), which is now the label for the scientific study of the process of aging, with the associated terms geriatrics for the treatment of old age disabilities and geriatrician for the practitioner in that field.

PHYSICAL AND PHYSIOLOGICAL CHANGES WITH AGE

The physical and physiological changes with age may be divided into two groups. First, there are those relatively rapid and pronounced changes, the date of whose occurrence is fairly uniform in all people, such as the appearance of the teeth, making possible a change from liquid to solid food, the maturing of the sexual mechanisms from 12 to

17 years of age, known as the adolescent period, and the menopause in women between the ages of 45 and 50 with its important physical and physiological changes. Second, there are the gradual and continuous changes in structure and function that occur from the moment of birth to death, as enumerated in the following statements by Howell (*296*, 1057-1058).

> The body increases rapidly after birth in size and weight. It is the popular idea that the rate of growth increases up to maturity and then declines as old age advances. As a matter of fact, careful examination of the facts shows that the rate of growth decreases from birth to old age, though not uniformly. At the pubertal period and at other times its downward tendency may be arrested for a time. But, speaking generally, the maximum rate of growth is reached some time during the intrauterine period, and after birth the curve falls steadily. Senescence has begun to appear at the time we are born.... The signs of old age may be detected in other ways than by observations upon the rate of growth. Changes take place in the composition of the tissues; these changes, at first scarcely noticeable, become gradually more obvious as old age advances The bones become more brittle from an increase in their inorganic salts, the cartilages become more rigid and calcareous, the crystalline lens gradually loses its elasticity, the muscles lose their vigor, the hairs their pigment, the nuclei of the nerve cells become smaller, and so on In every way there is increasing evidence, as the years grow, that the metabolism of the living matter of the body becomes less and less perfect; the power of the protoplasm itself becomes more and more limited, and we may suppose, would eventually fail, bringing about what might be called a natural death. As a matter of fact, death of the organism usually results from the failure of some one of its many complex mechanisms, while the majority of the tissues are still able to maintain their existence if supplied with proper conditions of nourishment.

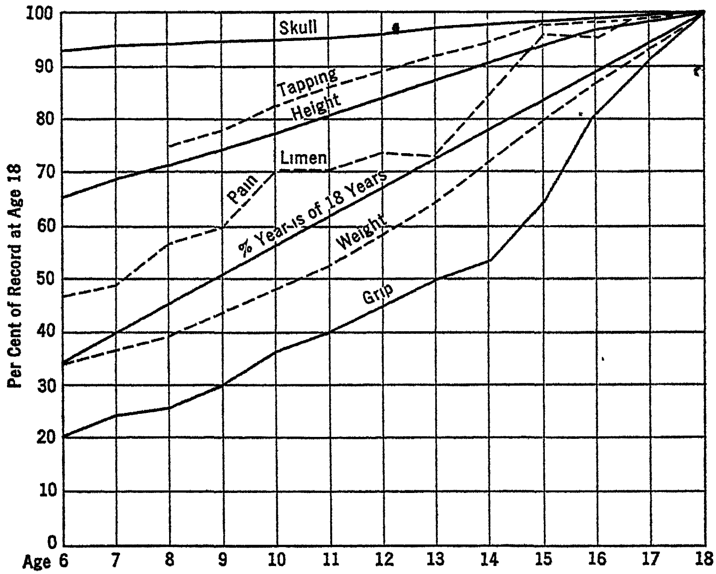
The special mechanisms which most commonly fail are the heart, the blood vessels, the kidneys, and the lungs. These changes are not so closely correlated with the number of years that one has lived that years may be taken as a sign of physical age. Examples of this lack of correlation between physical condition and age in years are abundant. Many a man of 70 years is physically younger than others of 45, and obvious signs of senescence are present in some persons who are chronologically relatively young. Realization of such disparity is leading to the development of new physical age standards with the result that it is legitimate to inquire whether one's age may not now be more properly measured in terms of blood pressure, kidney action, or some other physiological function than in years, months, and days. Cowdry (*117*) has assembled into one volume the evidence concerning the process of aging as it affects the cardiovascular system and the blood, the lymphatic system, the digestive system, the urinary system, the locomotor system, the skin, teeth, glands, the reproductive system, and the special sensory mechanisms of hearing and seeing. Although the conclusions

from this varied collection of material cannot be presented here, they should be consulted by the student of gerontology.

Careful measurements emphasize not only the great individual variations in physical and physiological development with age, but also the variation in the rate of development of different functions in the same individual. The curves in Figure 5 indicate the different rates of change in height, weight, and length of skull. In order to make the

FIGURE 5

Rate of Change in Physical Traits with Age



data comparable, all age values for the different measurements are expressed in terms of the value at 18 years of age, which is taken to represent 100. Measurements of this sort have not been systematically made beyond the age of 18 years. The figures along the base line show the chronological age, and those along the vertical show the percentages of the 18-year values. Differences in the shape of the curves will indicate differences in rate of development. For instance, the length of the skull changes only slightly but very uniformly from 6 to 18 years. Strength of grip, on the contrary, undergoes considerable change, with an increase in rate at the age of 14 years, the adolescent period. Between these extremes various rates of change appear. Each curve may be compared with the straight line which represents the change in chronological age upon the basis of 18 years as 100.

Table 7 gives the 18-year values for each of the traits as well as the units of measure for each. In the first column of the table are listed the traits; in the second is given the unit in terms of which the measurement was made; in the third appears the record for 18-year-old boys and girls, the values representing the average of the records for the two sexes.

TABLE 7

AVERAGES OF PHYSICAL TRAITS AT THE AGE OF EIGHTEEN

Trait	*Unit of Measure*	*Average Value*
Height	Centimeter	165.0
Weight	Kilogram	57 0
Skull length	Millimeter	189 0
Strength of grip	Kilogram	39.5
Tapping rate	30 seconds	195 0
Pain threshold	Kilogram	1.9

The figures just quoted are based upon different groups of children at each age. There is, therefore, a chance of error due to the possible change in the composition of the groups at different ages. Other studies of mental and physical growth *in the same persons* over a period of years have contributed much additional knowledge of the changes that take place from birth to maturity. Curves of physical growth have been constructed from measurements of the same individuals repeated at half-year intervals. On the basis of such curves it is possible to predict, within a certain error, what the physical character, such as height and weight, will be at the age of 16 years, if the height and weight at the age of 6 are known. A series of such growth curves prepared by Baldwin (*23*, 96) of two boys and three girls over a period of ten years, is shown in Figure 6.

Concerning these curves the author says:

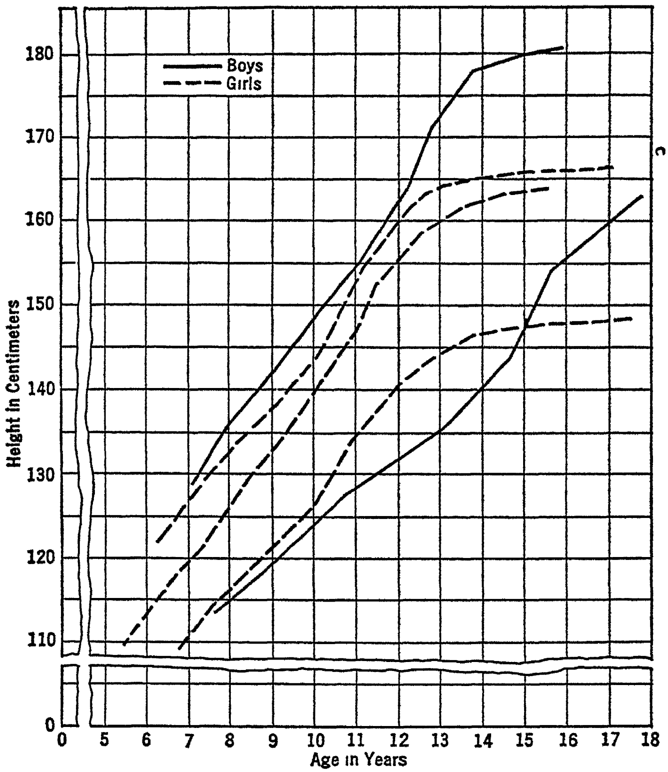
> In the 1914 bulletin it was discovered that the increase of growth in height is comparatively uniform for each individual, so that the growth curves enable one to prophesy with a high degree of accuracy how tall a child of normal growth will be in the subsequent age, providing his or her relation to a given median or norm is known In brief, tall children do not become short; neither do short children, as a rule, become tall under normal conditions. This discovery has been verified again with these new data.

Jones (*330*) and his associates at the Institute of Child Welfare of the University of California have published a detailed cumulative record of one boy over the age period from 12 to 18 years, covering his physical, physiological, motor, and mental development, his school record

as well as certain changes in personality, interests, and attitudes. Figure 7 is taken from this report by special permission of the authors. It represents a series of silhouettes prepared from photographs taken at yearly intervals. Casual comparison of the series gives an interesting impression of the varying rates of growth of the different body struc-

FIGURE 6

INDIVIDUAL GROWTH CURVES IN HEIGHT *



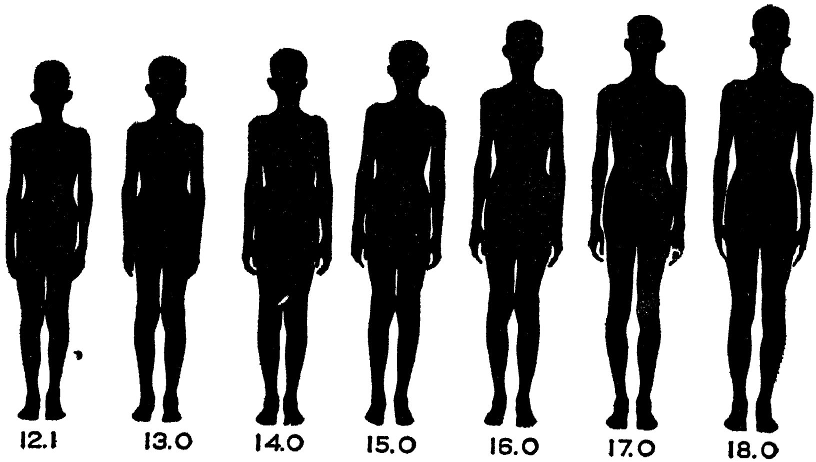
* From B T Baldwin, "The Physical Growth of Children from Birth to Maturity," *Univ. Ia. Stud. Child Welf*, 1921, *1*, No 1, 96

tures during these years. Changes in the dimensions of the head are the slightest, whereas those of the lower limbs are the greatest.

The study of the individual differences in physical and physiological characteristics shows that heredity is a very potent factor in the years up to maturity. Beyond that period, environmental influences and special habits of living have a considerable and noticeable effect on the bodily condition. Hence the struggle to keep physically young with increasing years, if properly managed, will have its reward, within limits.

FIGURE 7

SILHOUETTES FROM BODY PHOTOGRAPHS AT YEAR INTERVALS *



* From H E Jones, editor, *Development in Adolescence* (Berkeley, Calif, Institute of Child Welfare, University of California, 1941), p 11

EFFECT OF AGE UPON MOTOR FUNCTIONS

Changes in certain motor functions have already been demonstrated in Figure 5 where there are curves for rate of tapping with the finger and strength of grip upon a hand dynamometer. In tapping there is a gradual but fairly uniform increase in speed from the age of 8 years, where the curve starts, to the age of 18. Grip, on the contrary, shows an acceleration at the age of 14 years.

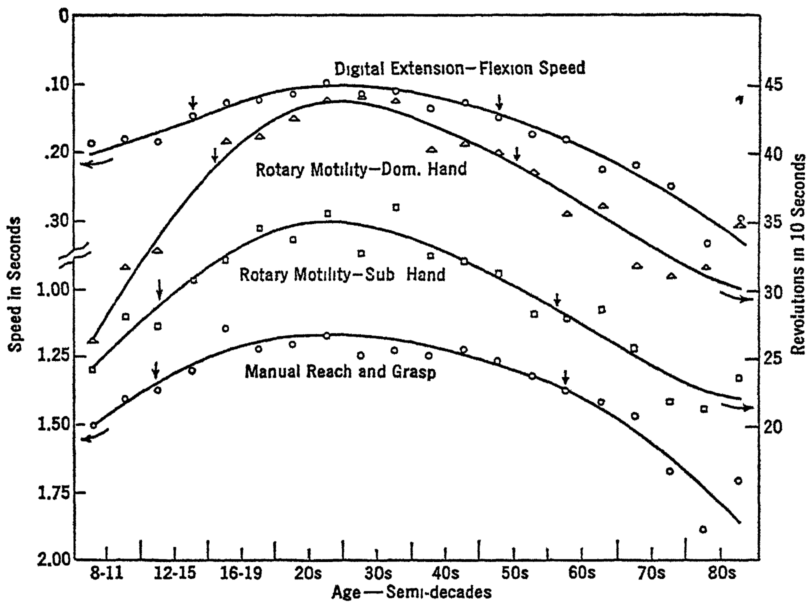
Data covering a greater age range than those so far presented are provided by Miles (*429*) for several functions that are of special significance to the applied psychologist. The reactions are concerned with hand movements such as flexion and extension, reaching and grasping, and rotation of the hand, and his measurements cover a period from 8 to 80 years. The movements that he measured are just such as would be involved in many of the high speed, highly coördinated motions required in industrial assembly work. The rapid pace and fine coördination needed are frequently said to disqualify older workers. Figure 8 shows Miles' curves for four kinds of hand control measured in some 300 cases. The vertical scale on the left gives speed in seconds for extension-flexion and for reach-grasps, the greater speed being at the top of the chart. The vertical scale on the right gives the number of rotations of the hand in each ten-second period. Here, too, the higher on the chart, the better the score. The horizontal scale shows age, in three-year units for the earlier ages and in ten-year units from the

age of 20 upward. Speed is seen to increase to a period somewhere in the 20's and to fall fairly steadily from there to the *highest age* on the chart. The significance of the changes which these curves indicate, in the opinion of Miles, is shown by the following statement which refers specifically to the reach-grasp reactions:

> The shape of this curve indicates a rather rapid improvement in coördination ability from eight to eighteen, only a slight change from then until age fifty, followed by a decline, quite definite, but I think surprisingly small.

FIGURE 8

CHANGES IN MANUAL REACTIONS WITH AGE *



* From W R. Miles, "Measures of Certain Human Abilities Throughout the Life Span," *Proc. Nat Acad. Sci.*, 1931, *17*, 629.

Individual differences are conspicuous at the greater ages.

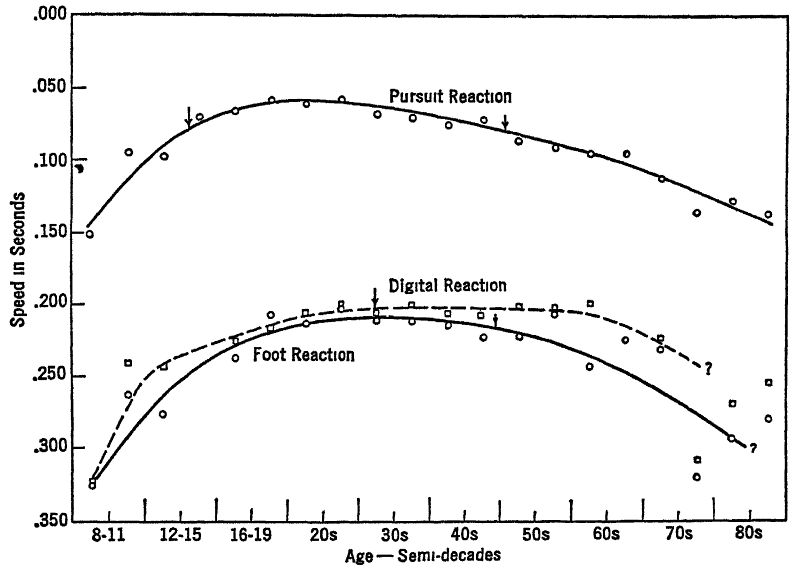
These records for the earlier years find support in the study by Messer (*426*) who tested over 900 children ranging in age from 6 to 18 years, on bead threading, wool knotting, and string knotting, all of them tasks that resemble industrial operations. There is a steady increase in efficiency of the three operations up to the eighteenth year.

Miles (*429*) also measured speed of simple reaction by the hand and the foot to an auditory stimulus, and the accuracy of a pursuit reaction by the hand. These three tests were applied to several hundred subjects covering ages from 8 to 80. The results are shown in Figure 9. The scales have the same meaning as those of Figure 8. Accuracy of pursuit is indicated by speed of reactions and is read from the same scale as

the reaction speeds. The pursuit movement increases in speed up to the age of 18, showing little change from there to the age of 30. Unlike the other reactions measured by Miles, this one begins to fall at the age of 30 whereas the others remain fairly steady until the age of 50. The reaction time for the hand only begins to slow up at about the age of 60.

FIGURE 9

CHANGES IN SPEED OF REACTION WITH AGE *



* From W R Miles, "Measures of Certain Human Abilities Throughout the Life Span," *Proc. Nat. Acad Sci*, 1931, *17*, 631

The data of Miles on reaction time can be supplemented at the earlier ages from figures published by Goodenough (*223*) who used the Miles reaction measuring equipment. A few of her figures, given in Table 8,

TABLE 8

CHANGES IN AUDITORY REACTION TIME WITH AGE *

Sex	*Age*									
	3½	4½	5½	6½	7½	8½	9½	10½	11½	College
Male	492	356	311	259	260	223	218	229	192	171
Female	518	424	356	286	250	249	202			172

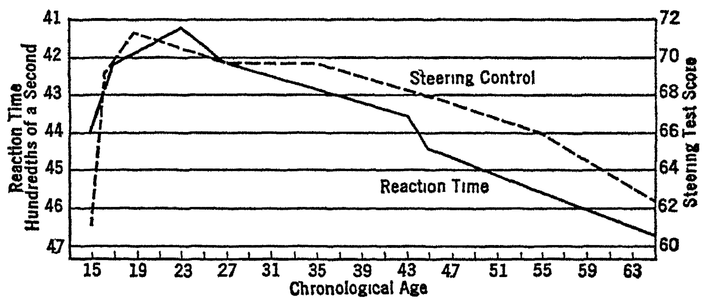
* Adapted from F L Goodenough, "The Development of the Reactive Process from Early Childhood to Maturity," *J. of Exp. Psychol.*, 1935, *18*, 437.

cover the age range from 3½ to 11½ years together with an older group of college students. The data in thousandths of a second are in terms of the median scores from 246 cases with the age groups varying in size from 7 to 56. Where her data and Miles' overlap, the reaction speeds of her subjects are seen to be very much faster. Careful reading of the reports suggests that Goodenough used stronger motivation than Miles. In spite of this difference in level of speed, it can be inferred that the slowest speeds occur at the earliest ages with a continual increase up through the age of 8 and reaching a maximum at about the age of 20.

De Silva (*131*) measured motor reactions in a situation more nearly resembling those of everyday life with his tests for automobile drivers. The first of his measurements shows the speed with which the foot can rise from the accelerator and depress the brake pedal. The second meas-

FIGURE 10

EFFECT OF AGE UPON AUTOMOBILE CONTROL *



* Adapted from H. R. De Silva, "On an Investigation of Driving Skill," *Human Factor*, 1936, *10*, 8, 11.

ures the ability to keep the car upon a straight course and involves eye-hand coördination like that of a pursuit meter test. The foot-reaction time records as they change with age are shown in Figure 10. The curve is an average of 2,000 cases ranging in age from less than 15 years to 65 years. The left-hand scale shows reaction time in hundredths of a second. The shape of the curve resembles in its essentials the curves of Miles. The loss in speed from the peak at the age of 23 to the age of 65 amounts to .06 seconds. At a driving speed of 50 miles per hour this increase in reaction time would amount to traveling about five additional feet before the brakes would be applied. The steering control curve, whose scale is on the right of the chart, has a shape very similar to that for reaction time, except that the peak performance is reached at the age of 19. There is a steady decline in efficiency in both functions from the age of 23 to 65.

These few samples are typical of the great body of evidence con-

cerning the changes in motor mechanisms with age, and will serve as illustrations of them (*428*). The following astute speculation of Miles (*429*, 663) concerning these changes would seem to warrant further research directed toward its corroboration:

> A possible theory then for the slower and more difficult action in the old is that neural conservation mechanisms are built up or become more potent, with increasing life-time A particular decrement according to this theory would not be chiefly chargeable to a defect in the mechanism but to a positive check on it—a neural governor device protective of the mechanism. The weight of years may be in large part neural inhibition-interference to action This is perhaps the core, or the basic behavior element, in the caution and proverbial good judgment of the old. Surely the self-depreciation and inferiority attitudes exhibited by the majority of older people in reference to action are scarcely warranted from our data Decrement appears more in feeling than it exists in fact.

EFFECT OF AGE UPON SENSORY FUNCTIONS

Vision and hearing are the most critical of the special senses for successful adjustment and they are likewise the ones in which the changes with age are most obvious. A certain deterioration in the sensitivity of the eye and the ear is recognized as the normal accompaniment of increasing age. Are the changes sufficient to interfere with the work of the individual and if so at what age does the handicap make itself felt? Data are available to answer both these questions.

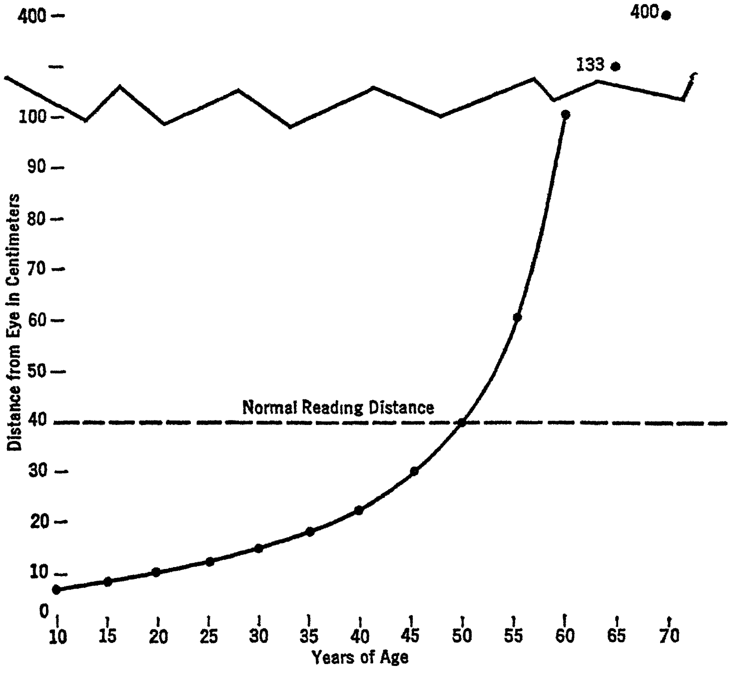
Clear, sharp seeing, which is the essential visual requirement, depends primarily upon the proper adjustment of the crystalline lens of the eye (*296*, 293-322). The possibility of this adjustment rests finally upon the elasticity of the lens or of the capsule which contains it, by virtue of which its convexity increases as the muscular tension upon it decreases. In the case of a normal young child the elasticity is such that an object will be in focus, that is, can be seen clearly, at as great a distance as its size will permit it to be seen at all and at a near distance only a few inches from the eyes. As one grows older this elasticity decreases at a well-known rate, with the result that the near point of vision recedes from a few inches to several feet. The course of this change in normal people is roughly indicated in Figure 11. The base line gives the year of age and the vertical line shows the distance in centimeters of the near point from the eye. It appears that up to the age of 40 years one can see small objects such as reading material at the customary reading distance from the eyes, which is about 15 inches. From the age of 40 years upward the near point of vision recedes beyond this distance. Objects to be seen sharply must then be held at greater and greater distances as age increases, until the age of 60 when the normal near point is 100 centimeters from the eye. At greater

ages the near point recedes still farther, because the power of accommodation has practically disappeared.

Fortunately, it is now considered entirely "normal" and acceptable to correct for this loss of the power of accommodation by wearing glasses, either for seeing at close range, or at all times by means of bifocals. What is merely an inconvenience to which most persons can readily adjust themselves, however, becomes a serious handicap in certain occupations where glasses cannot be safely worn. In a few instances,

FIGURE 11

CHANGES IN THE NEAR POINT OF VISION WITH AGE



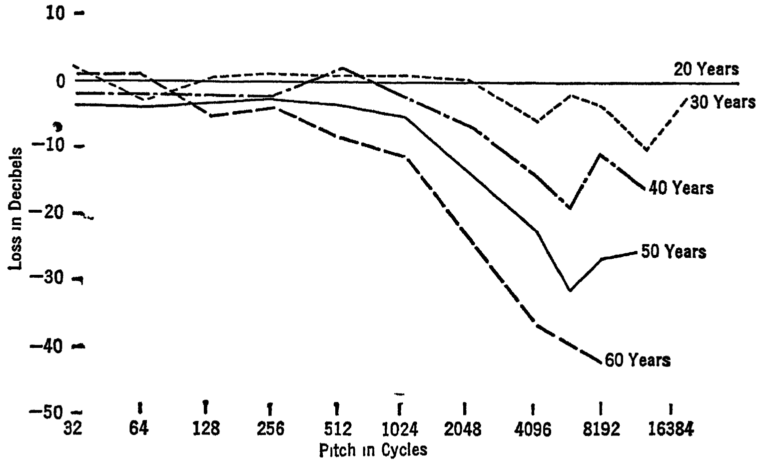
such as certain branches of the military service, the wearing of glasses is a cause for elimination. In the great majority of occupations in business, industry, and the professions well-fitted spectacles remove this handicap of age.

Hearing is likewise subject to normal deterioration with increasing age, although the changes in the auditory mechanisms which are responsible for it are not so clear as in the case of vision. The loss is a decrease in the acuity of hearing or a rise in the threshold, which shows itself in a needed increase in the physical intensity of sounds in order that they may just be heard. The facts of hearing loss with age are complicated because the amount of loss at any age depends upon the pitch

of the sound. In general the higher the pitch of the tone, the more rapid is the rate of loss. Figure 12, adapted from Stevens and Davis (*585*, 68), gives curves for five age groups varying in size from fifty-two to eighty-five individuals over a range of pitches from 32 cycles to 16,384 cycles. The horizontal scale indicates the pitch of the sound in cycles per second. The vertical scale is in terms of decibels,* a technical

FIGURE 12

CHANGES IN SENSITIVITY OF HEARING WITH AGE *



* Adapted from S S Stevens and H Davis, *Hearing Its Psychology and Physiology* (New York, John Wiley and Sons, 1938), p 68.

unit of intensity of sound, which can be roughly translated into sounds of everyday life by reference to the following scale (*166*, 103):

0—At the threshold of hearing for a normal 20-year-old
10—Sound level of an extremely quiet room
20—Sound level of a very quiet room
30—Ticking of watch at three feet
40—Tearing paper at three feet
50—Quiet electric motor at three feet
60—Quiet conversation
70—Loud conversation

Thus a person with a hearing loss of 30 decibels can just hear a watch tick at a distance of three feet but no farther, whereas one with a loss of 50 decibels can just hear a quiet electric motor at a distance of three feet.

It will be seen that the hearing loss is extremely slight for all ages

* For a description of the decibel, *see* S S Stevens and H Davis, *Hearing: Its Psychology and Physiology* (New York. John Wiley and Sons, 1938), pp. 29-31, 450.

up to 60 for sounds whose pitches are no higher than 512 cycles, which is one octave above middle C, and is still within about 10 decibels from normality for a pitch of 1,024 cycles, which is high C. When the vibration frequency gets above 2,000 then the loss at the greater ages becomes serious. The losses recorded in this chart are stated by Stevens and Davis to be probably a trifle too great, as the data were obtained from hospital patients.

What is the effect upon adjustment of the deterioration here noted to occur with advancing age? The ordinary sounds of everyday life can in general be heard and properly interpreted. Conversation of low intensity may cause some confusion, however, since the predominant pitch of some of the speech sounds, *i* and *s* for instance, falls within the higher levels of frequency. Loss of the high overtones from music may change its quality somewhat, but the change is not disturbing.

These hearing decrements which are normal for the aged do not constitute any practical handicap at all up to the age of 50, and a questionable one even to the age of 60. Where the change at a given age is greater than normal, or where loss occurs at an abnormally early age, correction is possible by one or other of the available hearing aids. There is no obvious reason why normal hearing losses should not be compensated for just as cheerfully as decrements in vision. There is very little if any popular resistance against old age glasses, or against glasses for the correction of any ocular deficiency. The time will doubtless come before many years when it will be just as common to keep one's hearing up to par with the passing years.

Outside of certain specific occupations and recreations which call for high sensory acuities, changes in the sensory mechanisms up to the age of 50 should constitute no problem at all. Beyond this age, corrective devices are available at least for vision and hearing which reduce the seriousness of the loss. Less is known about the other senses, but it is safe to guess that there would be a dulling comparable in amount to that shown in vision and hearing. But the consequences of such changes in taste, smell, and the skin senses are minimal for successful adjustments in everyday life.

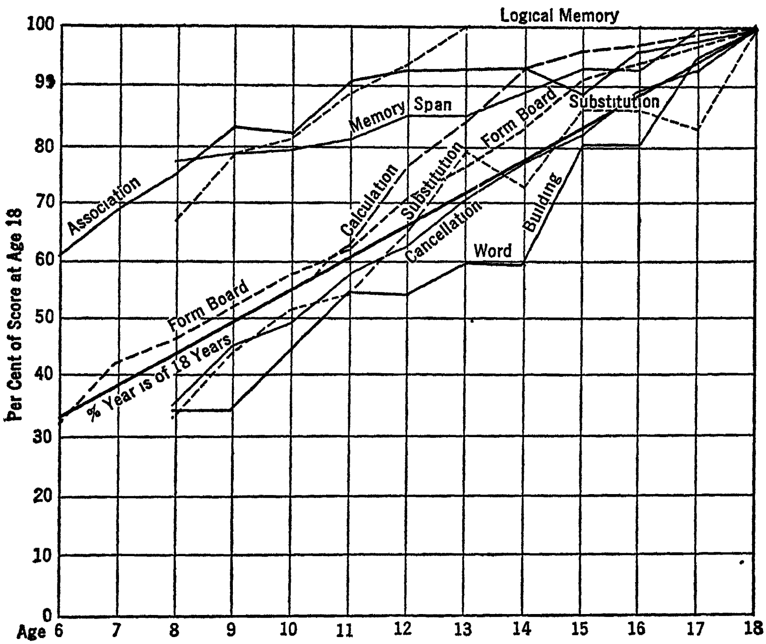
EFFECT OF AGE UPON INTELLIGENCE

The most portentous consequence of age so far as adjustment is concerned would be a gradual decrement in intelligence as one advances in years. From the very beginning of the era of testing it has been accepted as a fact that mental functions improve during the early years of the life span. It has been known, too, that functions differ in the rate at which they expand during these years.

Figure 13 will give some indication of the relative rate of change of a few mental functions in the earlier years. In order to make the data of the different mental traits comparable, they have been treated in the same manner as the physical traits described on page 46, that is, the records for 18 years have been taken as the standard, and the other ages are represented in terms of percentages of this 18-year record. Examination of the chart shows that logical memory reaches a maximum at 13 years of age with no change up to 18 years, whereas

FIGURE 13

CHANGE OF MENTAL FUNCTIONS WITH AGE



rote memory (measured by memory span) shows a more gradual increase with its maximum at about 17 years. Certain of the traits, for example, word building, have an increasing rate of improvement from 6 to 18 years, whereas others, like association, show a decreasing rate of improvement. The straight line represents the chronological age change in terms of 18 years as 100. To determine the rate of change of a trait, its curve should be compared with this age curve.

The values for the different traits at the age of 18 are given in Table 9, together with the unit of measure for each trait. Each figure represents the average record for boys and girls. From these figures and by reference to the curves the values for each age may be determined.

The curves just described were obtained from the measurement of

TABLE 9

AVERAGES OF MENTAL TRAITS AT THE AGE OF EIGHTEEN

Trait	*Unit of Measure*	*Average Value*
Memory span (digits)	No Items	8 6
Logical memory	No Items	37.5
Substitution	No Items	29 5
Cancellation	One minute	22 5
Word building	Five minutes	19.5
Associations (common)	Per cent	90 0
Form board	Seconds	10 0
Calculation	One minute	58 0

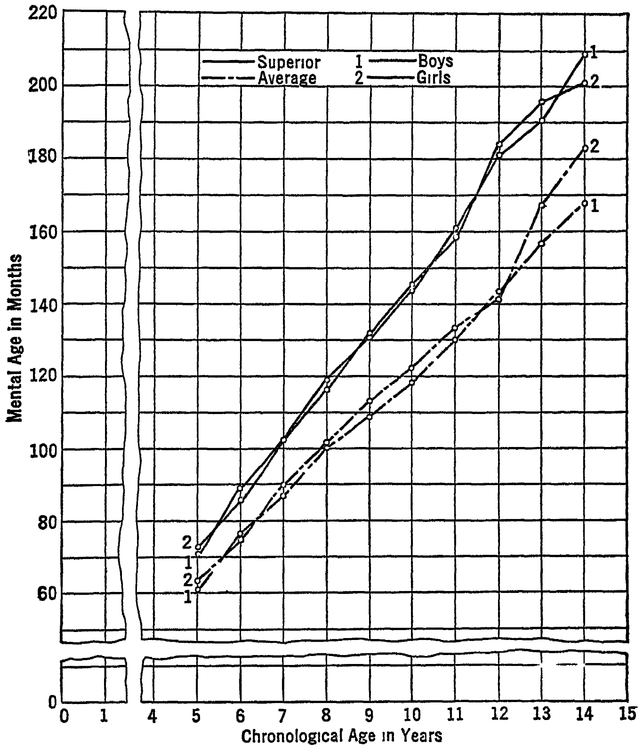
different children at each age. Those which appear in Figure 14, on the other hand, and which are taken from Baldwin and Stecher (*24*, 11), represent the annual measurements of two boys and two girls from the ages of 4 to 15 years on the Stanford Revision of the Binet Scale. Two of these are superior children (solid line), and two are average (broken line). The data are in terms of mental age which is indicated on the vertical scale, whereas chronological age is shown on the horizontal scale. There is a rather steady increase in mental age as far as the chronological age of 14 years where the curves end. The two superior children begin with a higher intelligence at the age of 5 years than the average children, and develop at a more rapid rate throughout the years. Physical and mental growth curves obtained from the cumulative records of a large number of children have more recently come from the Harvard Growth Study (*130a*) (*564a*) under the direction of W. F. Dearborn. The cases were followed for a period of 12 years beginning with the first grade in school. Although the particular slopes of these curves may be in part a function of the standardization of the tests, there is ample evidence that the battery of tests shows improvement with age.

The intelligence quotient (IQ) which expresses the relationship between chronological age and mental age reflects this growth in power, for the mental age when divided by the increasing chronological age tends toward a constant. A certain amount of fluctuation does occur in the IQ, but no more than the many variable factors that enter into its determination would lead one to expect. The amount of the fluctuation is now generally conceded to be about plus or minus five points. It should be safe to predict, therefore, that a child of 6 years with an IQ of 130, will at maturity, barring accident or disease, have an intelligence equally far above the average. How accurately the intellectual status could be predicted for late maturity or old age would depend upon the curves of change for those periods.

The curves of Figure 14 end just at a critical period, for intelligence tests seem to agree in showing that the curve begins to flatten out at about the age of 14 and that intelligence ceases to grow after 14, 16, or 18 years of age. This finding was the basis for the notorious statement

FIGURE 14

MENTAL GROWTH CURVES OF SUPERIOR AND AVERAGE CHILDREN *



* Adapted from B T Baldwin and L I Stecher, "Mental Growth Curve of Normal and Superior Children," *Univ Ia Stud Child Welf*, 1922, 2, No 1, 11.

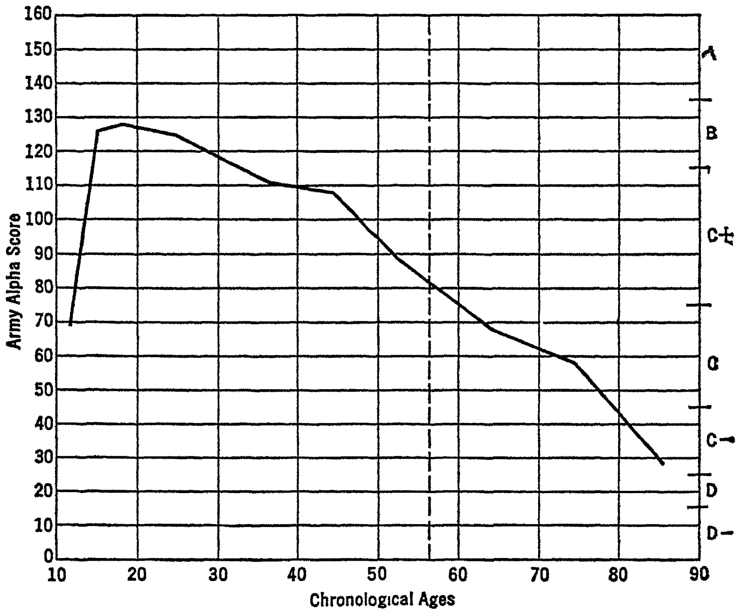
that the average adult in the United States has the intelligence of a 13-year-old child!

The huge body of data obtained from the use of intelligence tests in the army during the first World War gave the first real inkling of the nature of the changes during the mature years. From it there arose the suspicion that intelligence declined during the later years of life. The first substantial evidence concerning the course of intelligence change throughout the life span came from the Stanford University Later Maturity Research project under the direction of W. R. Miles. A short form of the Otis Intelligence Test with a time allowance of 15 minutes was administered by Miles and Miles (*427*) to 823 persons

ranging in age from 10 to 90 years. They called this a speed intelligence test. Their results for the series covering the longest age range (701 cases) are shown in Figure 15, in which the horizontal scale shows the chronological age, and the vertical scale on the left the Army Alpha score as interpreted from the Otis scores. The letter grades of the Army Alpha scores are shown on the right. There is the usual rise in score up to about the age of 15, when the curve rounds off to a high point at about 20 years. A steady decline then begins and continues throughout

FIGURE 15

CHANGE IN INTELLIGENCE WITH AGE*



* Adapted from C C. Miles and W. R Miles, "The Correlation of Intelligence Scores and Chronological Age from Early to Late Maturity," *Am. J. Psychol*, 1932, *44*, 51.

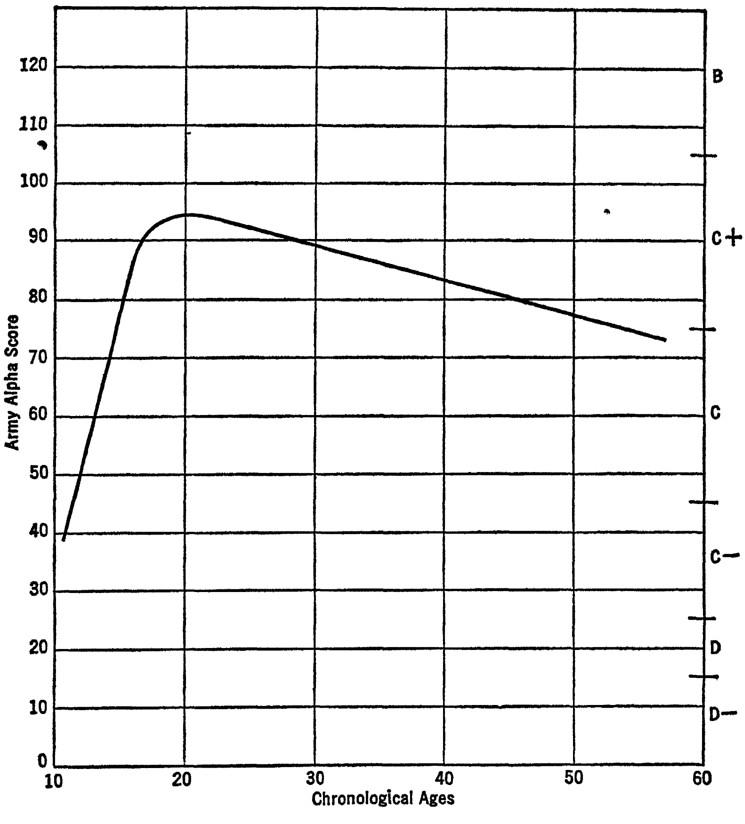
the extent of the curve. From the high point at 20 years to the age of 85 the decrease amounts to more than 60 per cent of the highest score. From 20 to 50 years there is a drop of about 18 per cent.

Miles and Miles are rather cautious in the interpretation of these large losses, suggesting the probable deleterious influence of tests standardized on young people and geared to speedy response. Sorenson (*572*), who used vocabulary and reading tests, finds improvement with age in the former and no loss in the latter. In the matter of the stability of vocabulary test performance he is supported by the work of Babcock (*19*) who uses vocabulary as a stable base from which to gauge intellectual deterioration (see pages 576, 591). He is inclined to discount

the significance of speed as a factor in the low scores of the older subjects. As his large number of subjects were attending adult education courses at the time they were tested, he finds them being exercised in the "in-school" sorts of reaction which are just what the tests measure. "Out-of-school" adults should, therefore, show a decline in score as

FIGURE 16

GROWTH AND DECLINE OF INTELLIGENCE
ARMY ALPHA SCORE *



* Adapted from H E Jones and H. S. Conrad, "The Growth and Decline of Intelligence," *Genet. Psychol Monog*, 1933, *13*, No. 3, 241.

Miles found them to do. This explanation seconds the Miles' view that intelligence tests are young people's tests.

Jones and Conrad (*331*) applied the Army Alpha intelligence examination to 1,191 members of nineteen New England villages, with the intention of thus studying a group of native-born white persons, geographically stable, and homogeneous in economic and educational opportunity. The ages ranged from 10 to 60 years. In Figure 16 is

given their smoothed curve, in which the data are in terms of raw score as shown on the vertical scale. The chronological ages are shown on the horizontal scale. The general shape of the curve is similar to that of Miles. There is a "linear growth to about 16 years, with a negative acceleration beyond 16, to a peak between the ages of 18 and 21. A decline follows which is much more gradual than the curve of growth, but which by the age of 55 involves a recession to the 14-year level" (*331*, 259). The whole layout of the test program led Jones and Conrad to conclude that the decline during maturity was not due to errors in sampling, to faulty test administration, or to variable motivation, understanding of directions, or remoteness of schooling. "It seems difficult to escape the conclusion that the basic intelligence of the older generation is, on the average, poorer than that of the younger. Whatever the advantage of age may be, it does not seem to lie in inherent basic capacity" (*331*, 258).

Lorge (*385*) has argued that the effect of age upon intelligence will be a matter of the measuring device used. The common intelligence tests such as the Army Alpha, he says, represent a mixture of speed and power, so that older persons with slower reactions are penalized when measured with them. He arranged three age groups 20 to 25, 27½ to 37½, and over 40, who were equated for score on the Thorndike CAVD test which is a power test, all making a score of 405 points. When these same groups were tested with the Army Alpha, with the Otis Self-Administering Test, and with the Thorndike Intelligence Test for High-School Graduates, all of which are mixed speed and power tests, their scores were as shown in Table 10. With no loss in power

TABLE 10

THE SPEED FACTOR IN INTELLIGENCE-TEST PERFORMANCE *

Age Range	*CAVD*	*Army Alpha*	*Otis S -A.*	*Thorndike H. S. Graduate*
20-25	405 3	149 6	44 4	66 9
27½-37½	405.7	142 3	39 3	60.3
Over 40	405 5	128.7	33.4	53.0

* From I Lorge, "The Influence of the Test upon the Nature of Mental Decline as a Function of Age," *J. Educ. Psychol*, 1936, *27*, 100-110

with age in his three age groups, there is nevertheless a loss of speed of reaction with increase in age as shown by scores on the three mixed speed and power tests. Lorge proffered a correction factor to allow for the speed penalty which age suffers in the Army Alpha, and which, consequently, would tend to equalize the age scores on this test.

EFFECT OF AGE UPON LEARNING

There is a well-established popular notion that childhood and youth are the ages for learning things, and that the new ideas one gets after early maturity are negligible in number. The adult-education movement which aims to continue the educational process throughout life had to combat this point of view in its early years with little scientific support. The research of Thorndike (*615*) and his associates published in 1928 has had much to do with opening the whole problem to scientific attack and with encouraging those who were promoting the adult education movement. He measured three age groups, 20 to 24 years, 25 to 34 years, and 35 years or over, in a variety of learning functions, from practice in drawing lines of given lengths with eyes closed and a minimum of guidance, to the learning of an artificial language. The results are reproduced in Table 11 where the learning achievement of the oldest group is expressed in terms of that of the youngest group. The greatest inferiority occurs in the first few tests in the table which measure as nearly as may be the "basic modifiability" of the organism. Other situations which allow for the play of interest, use of logic, and the application of the individual's store of knowledge show less handicap, with material as complex as university work being learned as readily by the old as by the young. Thorndike estimates an overall deterioration of about 15 per cent in learning efficiency during the years from the age of 22 to 45, or considerably less than 1 per cent per year.

TABLE 11

LEARNING AS AFFECTED BY AGE *

	Per cent old is of young
Drawing lines	64
Learning a letter code	61
Associating numbers with nonsense syllables	64
Learning to write with wrong hand	72
Learning an artificial language	79
Substitution of letters in words	81
Elementary-school studies	88
Practice in addition	96
University studies	over 100

* Adapted from E. L. Thorndike, *Adult Learning* (New York, The Macmillan Co., 1928), p 103.

The research by Ruch (*533*) supports the finding of Thorndike concerning basic modifiability. The former covered a greater age range with three groups of forty each, as follows: 12 to 17 years, 34 to 59 years, and 60 to 82 years. His five learning situations were set up so as to vary in the amount of the reorganization of preëxisting habit patterns required, that is to say, in the degree of modifiability needed

to achieve the change in behavior. The deficiency of the older as compared with the younger groups was greater for the tasks requiring the greater change.

OTHER CHANGES WITH AGE

In addition to age changes in physical characteristics, physiological function, motor efficiency, sensory acuity, and intellectual power there are probably emotional, volitional, and attitudinal changes. These are not easy to detect and to evaluate. Moreover, it is not possible to decide at present to what extent such changes as do occur are due to experience and circumstances rather than to chronological age. Some progress has been made in the study of the modification of interests with age. The chapter dealing with Interests (Chapter 18) will refer to this work so that detailed discussion of the question will be deferred. Early studies of interest seemed to show that they possessed a surprising stability even in very young children so that prediction of future interests and even future achievements could be based upon them. It is now generally believed that childhood interests change rapidly with increasing age since they rest upon no substantial background of knowledge. The interests of the adolescent, too, are rather unstable and really begin to settle down into a fixed pattern only in the neighborhood of the age of 25. From this age on there is relatively little change. Strong (*594*) has developed an interest maturity index, which shows the degree to which interest at any age approximates the pattern shown by people at the age of 55. In terms of this measure the age of 25 years becomes a critical period. It is well to think of these landmarks of interest in connection with the course of the curves of change in intelligence and in learning. The "freezing" of interests and attitudes has frequently been offered in explanation of deterioration in these functions. But the status of the adult over 25 years old, whom William James (*314*, Vol. II, 402) described as unable to get any new ideas, devoid of disinterested curiosity, and lacking the power of assimilation, may be in itself the result of waning basic modifiability.

PRACTICAL CONSIDERATIONS

It may not be easy for the reader to draw practical conclusions from the material presented in this chapter. He should recognize aging as a natural phenomenon with a waxing of functions up to a certain chronological age and a relatively static period, followed by a decline. This curve of growth and decline cannot be drawn with definite chronological points of change applicable to all persons. Here as everywhere

else in life, individual differences are the rule and not the exception. Nevertheless, the varied data which have accumulated suggest the age of 20 to 25 years as the terminal period of growth, and the age of 50 to 55 years as the beginning of the period of decline. However, there is no need to rely upon such general observations as these for mapping the period of growth. Tests are available and are now in common use that will determine an individual's status in important respects. Nor is it possible, in the absence of such tests, to set dead-lines whereby the modifiability, power, or energy requisite for a given kind of work can be determined. Tests of this sort are badly needed to tell whether a commanding general, a university president, an industrial executive, or a superintendent of schools has the minimum of what it takes to perform the functions of his office capably. There is badly needed also an objective attitude toward efficiency in the world's work, an attitude that will lead one to welcome such tests and to abide by their results. The applied psychologist should be the leader in the development of such a practical program.

It would be a safe estimate to say that one's maximal capacity in essential functions declines in the neighborhood of 1 to 1½ per cent a year from the age of 25 years to the age of 50 to 55 years, with a more rapid fall in the later years. It must be remembered, however, that the work of the world is seldom done at maximal capacity, for only in the rare emergency does one call forth his full power. The level of achievement that is attained at any age is much more likely to be a question of interest and incentive than of capacity. In general the observation of Thorndike (*615*, 177-194) can be recommended—that no one under 45 years of age need refrain from trying to learn anything that he wants to know or to do, nor can he offer age as a legitimate excuse for not learning what he ought for any reason to learn.

4

Learning and the Acquisition of Skill

The range and variety of specific adjustments that the human organism is natively equipped to make are unknown and may always remain so. The age at which modification of behavior first occurs has been pushed back beyond the date of birth with the discovery of the possibility of prenatal conditioning of behavior. With the birth date no longer accepted as the dividing line between the unlearned and the learned, no form of reaction is immune from the suspicion on the part of some investigators that it may have been acquired. Many of the "instincts" have long ago been transferred from the native to the acquired category. At last the native reflexes such as the grasping reflex are being explained away in terms of the conditioning process. Whatever the doubts and disagreements upon the question of nature and nurture, there is universal agreement that the human being cannot possibly long survive in the world on his unlearned reaction mechanism alone. How then do the necessary and desirable adjustments come about, whether they be the adjustments of the food-taking reactions or the adjustments requisite for success in a highly complicated social environment? This is a problem in psychology. It is the applied psychologist's task to discover how the individual can make his adjustments most profitable and satisfying to himself and to society.

The processes of behavior modification have a variety of names, among them being learning, habit formation, acquisition of skill, thinking and, possibly also, suggestion and imitation. All of them have so much in common that they can be discussed economically in two groups, the first, learning and the acquisition of skill, and the second, thinking and suggestion.

THEORIES OF LEARNING

Many theories have been proposed for the explanation of the learning process. The applied psychologist need endorse no one of them. On the contrary, he may pick and choose among them, taking only

those aspects of each that have the most substantial factual support and that seem to have the greatest practical value, discarding the remainder. Three of these theories have something to contribute and therefore deserve his attention. They are the conditioned-response theory, the trial-and-error theory, and the insight theory.

The conditioned-response theory is an association theory in which contiguity appears to be the potent factor in making a connection between a stimulus and a response. It may be stated in a variety of ways. Guthrie (*235*, *26*) expressed it thus: "A combination of stimuli which has accompanied a movement will on its recurrence tend to be followed by that movement." A more conventional statement would be that if a stimulus leading to a response is accompanied by another stimulus, the occurrence of this latter alone will tend to be followed by the response. Pavlov's (*488*) experiment on the conditioning of the salivary reflex in a hungry dog will illustrate the process. If the ringing of a bell or the application of an electric shock accompanies the presentation of food which causes a flow of saliva, then, on a later occasion, the ringing of the bell only or the application of the shock only will tend to cause the flow of saliva.

The process of insight is difficult to describe, but it would seem, according to Koehler (*350*, 349), to consist of a period of observation leading to understanding and followed by an appropriate response. Thus Koehler's (*351*) ape in the well-known jointed stick experiment, after being unable to reach a banana through the bars of its cage with a short bamboo stick, retired to the back of its cage. In the process of handling two sticks it inserted one into the end of the other, observed the result and straightway went to the bars where with the now longer stick it drew in the banana and ate it. And Kellogg's (*337*) child, when seeing a screen placed between itself and some object it wanted, observed the obstruction, ran around the end of it, and obtained the object.

The trial-and-error theory would seem at first sight, at least, to be in sharp contrast to the insight theory. It applies a series of reactions more or less random in nature, but directed toward some end such as the obtaining of food, with the gradual restriction of the range of movement until the right response occurs as though by accident. Upon later occasions the correct response occurs more and more promptly until it follows at once upon the stimulus. Thus Thorndike's (*616*) hungry cat, when placed in a cage whose door could be opened by pulling a looped string, and in front of which a morsel of food could be seen, struggled to obtain the food. It scratched and clawed around the box, but mainly in the direction of the food, and in the course of its struggles it happened to catch the loop which opened the door. After

many repetitions, the cat, when confined in the box, immediately pulled the loop and obtained the food. It had learned.

COMMON GROUND OF LEARNING THEORIES

Closer inspection of these theories shows rather striking resemblances. Guthrie (*235*, 190) has pointed out that the illustration of learning by insight given by Wheeler is an excellent description of trial and error entirely acceptable to those who support the latter theory. Wheeler (*700*, *252*) says:

> When you train your fox terrier to sit up and beg, you reward him with a tidbit not thereby to vivify the muscular sensation of making the correct movements, but in order to provide the dog with a definite goal with respect to which it will execute the desired act. Dog-fashion, it will then understand what you want of it, for responding with respect to food goals falls well within the repertoire of dog insight! Dog insight is relatively feeble and slow of development, especially under artificial conditions, consequently considerable time will elapse before it will make its movements just as you want them. Meanwhile it is making numerous other movements all at about the same time, jumping, barking and running around; which of these is to function as the "tool" for the securing of food is the difficult problem you have imposed upon it. As the dog keeps trying, its insight into the situation grows, just as the human being on a higher plane solves a mathematical problem by continued performance with respect to a definite goal.

Durkin (*152*, 83), who studied human problem solving, saw no sharp distinction between insight and trial and error.

> Problem solving in human adults is never completely blind or random, although O may proceed to his goal by manipulating the material without seeing ahead the relation of his moves to the goal.... On the other hand, it is, except in the simplest cases, to some degree exploratory, and always requires some manipulation, if only for verifying a correct hypothesis. It is not that a new kind of process, that of seeing the relationship of the material to the goal, enters in at the level of so-called "insightful" thinking, but that that process was there in nucleus, though but vaguely, from the beginning, in the "blindest" variety of trial and error. Whether this is an independent process or is based genetically on trial-and-error or conditioned response, is not established.

The final sentence of Durkin suggests a common ground not only between trial and error and insight, but between conditioning and the other two. Resemblances between trial and error and conditioning have been mentioned by other investigators also. The similarity is disguised by the fact that in conditioning the final response, in the sense of the end to be attained, is predetermined and has only to be associated or connected with the new stimulus. But when attention is directed to the pattern of movements by which the response develops in the course of

the conditioning, its variations from trial to trial become evident. The stimulus pattern likewise varies in its composition as the response is being established. Moreover, learning by conditioning resembles insightful learning in that the number of trials necessary to establish the response becomes fewer and fewer as the experimental conditions are more rigidly controlled. It would seem, therefore, that perfect control of stimulus conditions might be expected to establish the response in a single trial, just as happens in cases of "good" insight.

This brief survey of theories of learning and their similarities gives clues to the necessary conditions for learning, which hold for all theories. In the words of Miller and Dollard (*431, 2*), "In order to learn one must want something, notice something, do something, and get something. Stated more exactly, these factors are drive, cue, response, and reward." The drive may be a need, a desire, or a habit. In the illustrations used above it was hunger. The cue may be the "tool" mentioned by Wheeler and derived from observation, understanding, knowledge (getting acquainted with or seeing into a situation), insight, or it can be just stumbled upon. The response, or the responses, may be immediate and adequate or variable and gradually approaching adequacy according to the conditions under which the learning takes place. What the organism gets may be a reward in the sense of direct satisfaction as in obtaining food, or relief from punishment as in the escape from an electric grid.

MOTIVATION IN LEARNING

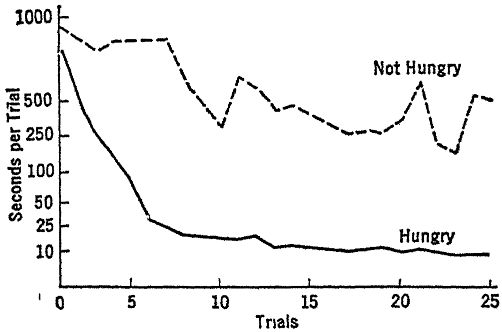
"All behavior is motivated." With this sentence Young (*731,* 1) opens his extensive treatment of motivation. One has to accept the statement largely on faith for it is difficult, if not impossible, to control all motivating influences in experiments with animals, and it *is* impossible to do so in human research. For it can be said that an animal which learns a maze, in the absence of hunger or other clearly identifiable motivation, is driven by the urge to explore, by curiosity, or perhaps just the urge to be active. If one averts the question whether it is possible ever to learn at all without motivation, he can comfortably accept the statement that one invariably learns more readily when motivated and the stronger the motivation up to some limiting point the readier the learning.

An earlier chapter listed the so-called native drives, and mentioned many others whose origin is not so clear. The former are the easiest to work with and are the only possible ones to use in animal studies. A large body of evidence has accumulated concerning the motives and their relative strength in animals (*677*). The curves from

the work of Ligon (*378*, 42) reproduced in Figure 17 are representative of the results obtained in animal studies. The data are in terms of the time in seconds required for groups of rats to run through a maze, when hungry (solid line) and when not hungry (broken line). There is a striking difference between the learning curves of hungry and satiated rats. It will be obvious that cases of motivation such as this one are in part anticipations of reward and as such are covered in what will be said concerning that aspect shortly. For although the animal may be driven by the pangs of hunger or because of some chemical deficiency to arrive at the food box on the first occasion, thereafter it seeks food. The overlap between drive and reward (or punishment) is particularly

FIGURE 17

Effect of Hunger Drive upon Learning*



* Adapted from E. M. Ligon, "A Comparative Study of Certain Incentives in the Learning of the White Rat," *Comp. Psychol. Monog*, 1929, *6*, No. 28, 42.

great in learning, and for that reason the former can be more appropriately discussed under Reward in this chapter. The effects of specific rewards upon the behavior of children and adults will be considered at length in the chapter on Incentives. It will be enough to say at this point that motivation must be naturally present or must be provided if learning is to be achieved. A child's learning may be accelerated because he likes candy, wants to please his mother, to excel over his classmates, to avoid staying after school hours, to earn a new toy, to get information he wants for some purpose, or to pass his examinations. Which ones of the almost unlimited range of motives will be employed and which ones will be most effective in any specific instance are matters that need inquiry.

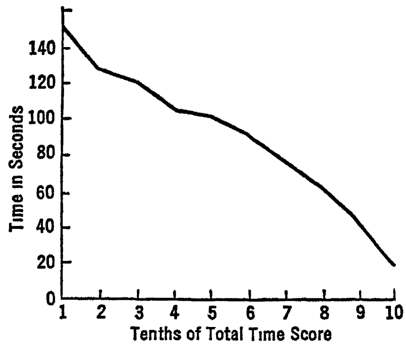
THE RÔLE OF UNDERSTANDING

Two kinds of processes are distinguished by Pear (*490*, 37) in the acquisition of skill, one being "blind learning" and the other "thought-

ful learning." The former would seem to represent the extreme form of trial and error where understanding or cues are absent or impossible to obtain at the beginning of learning, and the latter would represent the case where the adequate cues are present at the outset of the process or are speedily found. *Training,* for Cox (*118,* 6), is a process in which cues or insight or understanding are provided for the learner by proper instruction from some competent person and to be distinguished from *practice* in which "the worker repeats the operation more or less mechanically at maximum speed." He makes a further interesting and important distinction within the same skill-forming process between a "thinking-out function" and a "putting-together function" (*118,* 18). In an assembling task the latter can be distinguished from the former by "ensuring that at the outset the individual thoroughly understands how the parts are to be fitted together." Under ordinary circumstances, at least where some instruction is furnished, understanding would come first to be followed by the "putting together." Tasks differ in the relative importance of the understanding factor, from the case where the process is "blind" to the case where there is complete insight. Figure 18 from the study of Shuey (*564,* 332), who tested problem-solving in kittens, gives a curve for "blind" learning, that is, where cues were reduced to a minimum. Improvement is uniform throughout the extent of the curve, with no sharp decreases in time. Figure 19 from Cox (*118,* 111) shows the curves for the task of assembling an electric lamp socket. The upper curve marked "without" shows the performance of

FIGURE 18

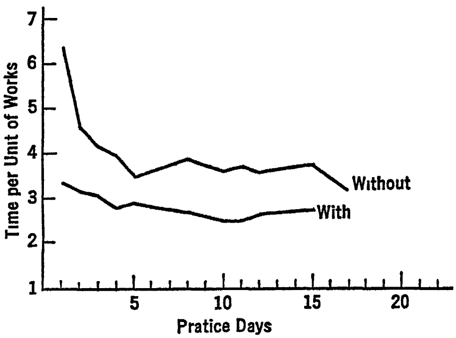
PROBLEM-SOLVING IN KITTENS *



* From A M Shuey, "The Limits of Learning Ability in Kittens," *Genet. Psychol. Monog*, 1931, *10,* 332.

FIGURE 19

EFFECT OF UNDERSTANDING UPON LEARNING *

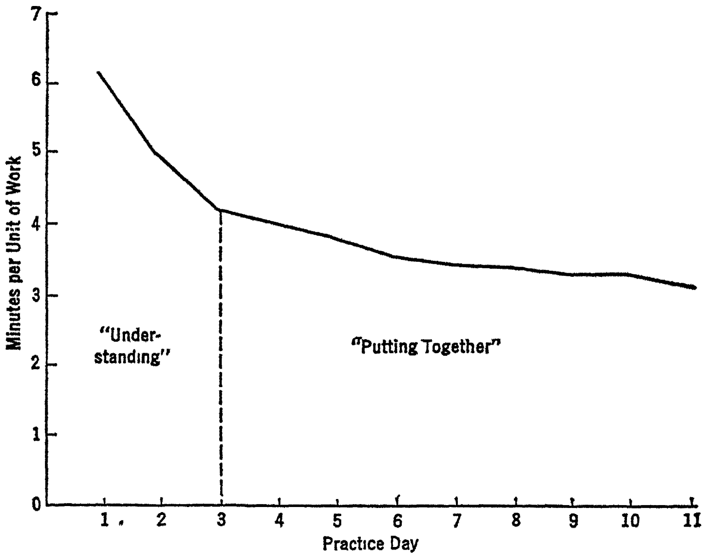


* Adapted from J. W Cox, *Manual Skill* (London, Cambridge University Press, 1934), p 111.

a person who began without cues or understanding, but acquired it during the first few days, giving a rapid fall in the curve. The curve marked "with" represents the performance of a person who had full understanding of the task at the outset, with the result that his curve begins about where the other subject had arrived after five days of training. Woodworth (*711*, 146) has prepared strikingly similar curves from the work of Twitmyer for learning of the blindfold maze by human subjects, some with understanding derived from previous visual inspection of the maze and some working "blind." The former saves the equivalent of the first third of the curve of the latter.

FIGURE 20

Practice in a Function Requiring Understanding *



* Adapted from J. W. Cox, *Manual Skill* (London, Cambridge University Press, 1934), p. 124.

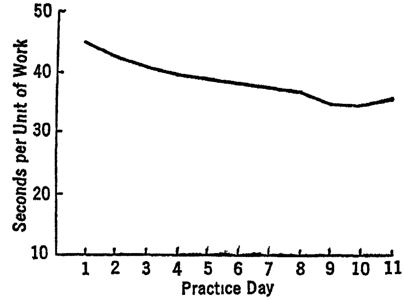
Tasks differ also in the necessary proportions of the "thinking-out" function and the "putting-together" function, to revert to the terminology of Cox. In Figure 20, Cox (*118*, 124) shows an average curve for about forty subjects assembling electric lamp sockets without previous instruction. The early part of the curve covering the first three days of training shows by the rapid descent the development of understanding. The curve from this point on to the end marks the "putting-together" function. In contrast to this curve is the one given in Figure 21, also adapted from Cox (*118*, 124), showing progress in inserting screws into the lamp sockets. This is a purely motor function calling for coördination of fine movements but with the understanding factor at a mini-

mum. The curve marks a slow but steady increase in speed from beginning to end.

The practical conclusion to be drawn from an examination of these curves is that, for maximal efficiency, "training" should replace "practice." Instruction should be given and cues provided wherever possible. In the laboratory, a rat is put into a maze in order to study how it learns to avoid blind alleys and take the shortest route to the goal. If one were practically interested in having the rat make the run as efficiently as possible, all blind alleys might be closed until the correct path had been learned. The postman on a new route or the milkwagon horse would not be left to trial and error to find his way, but would be guided along it. The more complicated skill should be developed in the same way. The correct form in tennis and golf, in typewriting and in assembly operations, in adding figures and in reading, cannot be left to the *non-understanding* individual. What is correct must be worked out beforehand and taught. This is one of the essential aspects of any industrial efficiency system, and of any good educational system. There are instances, of course, where correct cues cannot be provided beforehand—as in meeting an entirely new and strange situation. In such cases understanding must be arrived at by the process of thinking or reasoning on the part of some one. Such cases will be examined in the following chapter.

FIGURE 21

PRACTICE IN A FUNCTION REQUIRING ONLY MOTOR SKILL *



* Adapted from J W Cox, *Manual Skill* (London, Cambridge University Press, 1934), p 124.

REPETITION

Understanding is, however, not the whole of training. After the rapid fall in the curve of learning, progress continues as in Figure 20 and it continues likewise where only motor control is called for as in Figure 21. It is here that the response and the reward aspects of the learning process enter. The subject must actively react in order to improve, the rat must run in the maze, the child must try to write or to recite his lesson, the adult must swing at the golf ball. One of the oldest and best known of the so-called laws of learning is that of repetition or frequency of response. "Perfection does not come without practice." Recent research has shown, on the other hand, that repetition in and of

itself will not inevitably bring about improvement. Its effectiveness seems to reside rather in the opportunity it affords for modification and variation of response and for the selection of the "correct" response where the initial cues are lacking or are inadequate. There are instances where learning occurs with one experience as in certain cases of conditioning and of insight. And there are also instances where no learning occurs in spite of many repetitions (*623*, 6-63), due perhaps to absence of an intention to learn, to lack of motivation, or to the presence of fatigue.

INTENTION TO LEARN

It is difficult to design an experiment in human learning where there will not be some intention to learn, although one can find many illustrations from one's everyday experience of the dependence of learning upon intention to learn. For instance, the writer has in the course of certain experimental work named a series of 100 colors (five different colors, each repeated twenty times, arranged in random order) over 1,000 times in order to measure his speed of reading, and he never learned the list so far as to be able to recall even the first three colors. Here the intention was to gain speed in reading and not to remember. One's ignorance of situations which one meets daily during many years testifies to the importance of this intention to learn. The inability to describe correctly the face of one's watch is a striking example.

The few available experimental studies of "incidental" memory (*457*) (*556*, 4-15) have demonstrated the correctness of these more casual observations upon the necessity of the intention to learn. No small proportion of the success attained through the use of mnemonic systems comes from the intention thus created to pay attention to the material to be learned.

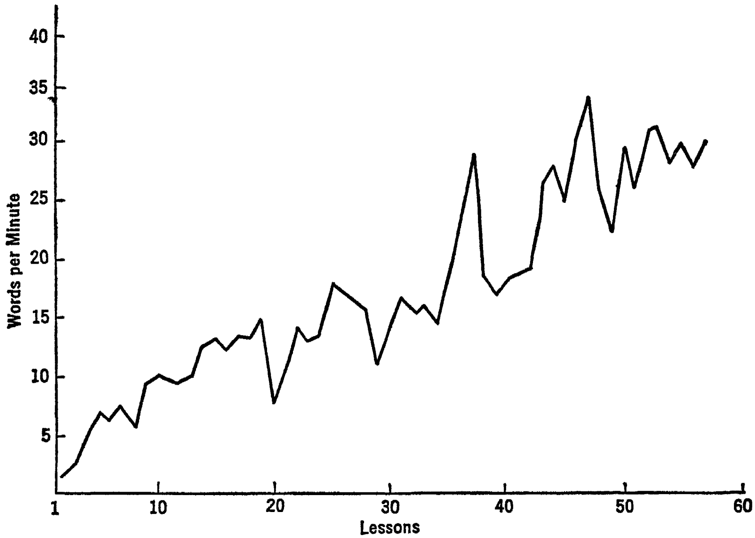
It is not easy to discover the shape of the learning curve in a situation where there is intention to learn, but without specific reward or without insight. Barton's (*29*) curve shown in Figure 22 approximates that condition. It represents progress of a group of students in typing where there certainly was a mild intention to learn but with a minimum of motivation, insight, and reward. The curve approximates a straight line with the usual fluctuations due to a variety of uncontrolled influences. But there is steady improvement.

This facilitating effect of intention to learn calls for an interpretation in more objective terms, if possible. Intention to learn means being interested in knowing something or doing something and attending to it. These in turn are reducible, in part at least, to increases in muscular tensions in the sensory mechanisms and very probably also in the motor mechanisms (*184*, 367-394). There is some experimental evi-

dence to suggest that such tensions do have a facilitating influence upon behavior. There is negative evidence from the work of Jacobson (*310*) showing inefficiency of performance in a state of muscular relaxation, and positive evidence from the research of Bills (*40*) and others on the reinforcing effect of muscular tensions, both those occurring naturally and those that are artificially created. The data obtained by Block (*49*) make it appear that there is such a condition as over-tension which

FIGURE 22

LEARNING CURVE FOR TYPEWRITING *



* From J W. Barton, "Smaller vs. Larger Units in Learning to Typewrite," *J. Educ Psychol*, 1921, *12*, 473.

when extreme may not only fail to facilitate but may even interfere with performance Mere intention to learn is not likely, however, to create tensions of such magnitude.

EMOTIONAL REINFORCEMENT

Emotional excitement may strengthen the effect of repetitions so much that in exceptional cases there is no need for more than one or a few repetitions of an experience. The psychoanalysts rest heavily upon such excitement to account for the devastating effect of emotional episodes. Guthrie (*235*, 103-113) explains the reinforcement produced by excitement in terms of body tensions, or what Freeman (*184*, 433-459) describes as "proprioceptive backlash." It would seem, though, in the light of the brief comments just made concerning the effect of

strong tensions, that great excitement or too great excitement might impede learning Certainly excitement vigorous enough to create confusion should do so. Instances of amnesia due to such a cause could, doubtless, be found. At any rate intention and mild emotional excitement are generally regarded as facilitators of the learning process.

REWARD AND PUNISHMENT

One of the best known of the so-called laws of learning and the one that has aroused the most controversy in recent years is the law of effect, which says that a satisfying after-effect tends to stamp in the response that produced it, and that a dissatisfying after-effect tends to inhibit the response that produced it. There is a serious theoretical difficulty in accounting for such a retroactive effect of satisfaction or dissatisfaction upon the reaction that created it, as pointed out by Cason (*94*), but the fact remains that in practical life situations, in the training of animals, in the teaching of children at home and in school, and in the learning of skills by adults, rewards and punishments are effective in the long run. The isolation of these influences from the complexity of factors affecting learning is difficult in the work with animals and particularly so in the case of human beings For instance, reward or punishment once administered leads to the anticipation of the same in future trials, and provides one of the most common forms of motivation or incentive to improvement (*678*) The fact of the influence of motivation in learning having been established, one may question whether improvement is due to the reward or punishment directly or to the increased motivation. The same overlapping of influences undoubtedly occurs in animal training also, though probably not to the same degree.

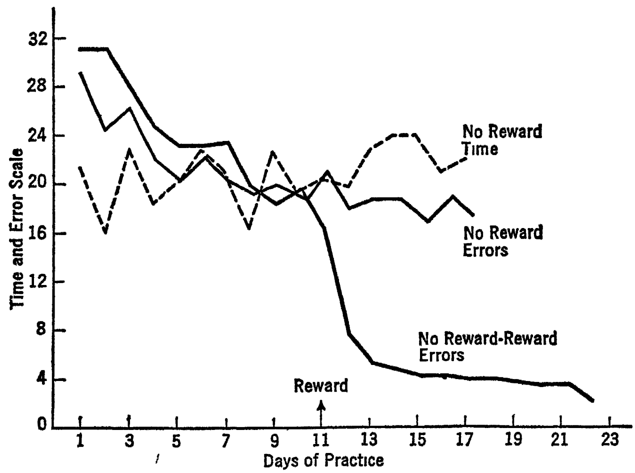
The change in the rate of learning through reward, in a relatively pure form, is demonstrated in Figure 23 from the work of Tolman and Honzik (*648*). They ran rats through a maze, taking them from the food box at the end of the run without a food reward. After ten trials of this sort, the rats were rewarded with food at the end of each of the succeeding eight runs. The records are in terms of errors made per trial and time per trial. The rapid fall in the error curve upon the administration of the reward is obvious. It should be noted, however, that there is much improvement in error score during the first ten trials in the absence of the food reward. It is not possible to say whether some uncontrolled reward such as escape from the maze was at work in the early part of the curve or whether the improvement was the consequence of sheer repetition. Some vague motivation was certainly present for the animals did move around in the maze, but

there can be motivation, of course, in the absence of reward or punishment. The influence causing reduction of errors in the absence of reward was not effective in reducing the time spent in running the maze, for the broken line in the chart, indicating time score, does not fall. Whatever may be the interpretation of the early part of the curve the fact remains that giving a food reward at the end of the run increased the rate of learning.

Guthrie (*235*, 153, 158) attempts to resolve the conflict between theory and practice in the use of rewards and punishments, at least so far as the process of conditioning is concerned, with the opinion

FIGURE 23

EFFECTS OF REWARD UPON LEARNING*



* Adapted from E C Tolman and C H Honzik, "Degrees of Hunger, Reward and Non-Reward and Maze Performance in Rats," *Univ Calif Publ Psychol*, 1930, *4*, 267

that it is not the reward and the punishment in themselves that have the effect but what they make the animal do that counts. In support of this view he cites cases, exceptional to be sure, in which reward impedes the fixing of a correct response and punishment facilitates it. Thus, if one is training a dog to sit up and beg and the food reward, instead of being given to it while it is in the begging posture is thrown into a far corner of the room, the reward will fix the running for the food instead of sitting for it. Likewise, if a dog is being trained to jump through a hoop, a smack on its posterior, a punishment, administered at the proper moment, will send the dog through the hoop and tend to fix the correct reaction. An even more instructive instance is cited by Miller and Dollard (*431*, *32*) in which a mother is teaching her child to play the piano. The child received no reward such as the

sight of the mother's pleasure when correct notes were struck whereby these responses might have been reinforced. His only reward was permission to run away from the piano when his work was well done. Therefore the whole set-up emphasized escape from the piano rather than good work while at the piano.

These instances of failure of rewards and punishments to accomplish what is expected of them offer no argument against their use, but they do emphasize the necessity for their *intelligent use*. A later chapter on Incentives (Chapter *22*) will deal in part with just this question, and will show the need for an intelligent appreciation of these tools.

DISTRIBUTION OF PRACTICE

An efficient learning program demands consideration of other factors than motivation, understanding, repetition, and reward. A large body of research data is available on such questions as how one shall spend his available learning time and how he shall organize the material to be learned. If the exact influence of fatigue, practice, and a number of other factors involved in learning were known, one could arrange beforehand the time schedule that would be most economical for learning. But since we do not have such knowledge in sufficient detail, the problem has to be attacked empirically. Various tasks are set and a given amount of time allowed for learning. This time is differently distributed for different individuals, some spending theirs in one continuous work period, and others dividing it into portions separated by unoccupied intervals.

The conclusion that has been drawn from experiments of this type is that too great concentration or distribution of time is not economical. The learning periods should be short enough to avoid the onset of fatigue, and long enough to avoid the loss of too much time in getting warmed up to the task at the beginning of each learning period. No absolute rule can be laid down for all individuals, but it can be safely said that a moderate distribution of time always gives more economical results than spending the same amount in one continuous study period (*523*). The same facts are applicable to motor learning or muscular activity.

Interesting evidence concerning the proper distribution of time in a practical learning situation is derived from an investigation of chain assembly by Henshaw and Holman (*256, 26*). Four work schedules were tried in the training for this task. They were:

I. Sixteen ten-minute training periods of chain assembly per day with rest interval following each one, eight periods in the morning and eight in the afternoon with a lunch hour at noon.

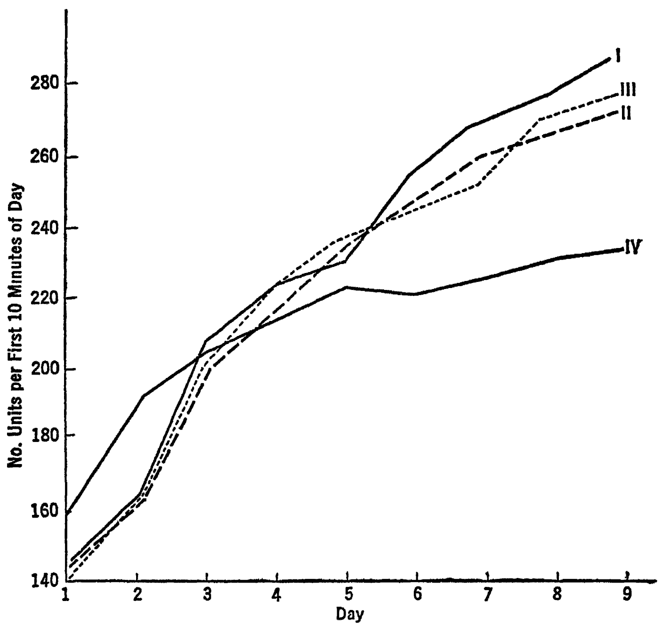
II. Eight ten-minute periods at chain assembly in the morning, with eight periods in the afternoon spent in a rather similar task of cartridge filling
III. Eight ten-minute periods of chain assembly each morning with no work in the afternoon.
IV. One ten-minute period only of chain assembly per day.

The results of these schedules are given in Figure 24 where the curves are in terms of the number of units per ten-minute period at the beginning of each day. The first point on the curve gives the stand-

FIGURE 24

PRACTICE CURVES IN CHAIN ASSEMBLY *

I—Two 80-minute training periods—chain assembly
II—{One 80-minute training period—chain assembly; One 80-minute training period—cartridge filling}
III—One 80-minute training period—chain assembly
IV—One 10-minute training period—chain assembly



* Adapted from E M Henshaw and P Holman, "Manual Dexterity," *Industr. Hlth Res. Bd Rep*, 1933, No 67, Part II, 26.

ing of the groups at the beginning of the training. The curves for programs I, II, and III are practically indistinguishable. They show that whereas program I had double the practice of program III on each day, the rate of learning did not differ. Curve IV differs from the others

in that the rate of improvement was very much slower, indicating that only ten minutes of practice per day was entirely too little for efficient learning. There are certainly extremes of dispersion and concentration beyond which it is not economical to go. Within these extremes other practical considerations will determine the program, such as the date at which the trained person's services will be required. It is entirely possible, for instance, that no matter how much faster one might learn with the shortest daily practice, the learning time would have to be more concentrated to meet practical requirements.

Comparison of curve II with curves I and III suggests that the groups learned two related tasks without interference between them, for II is neither worse nor better than I and III. Caution should be exercised in the practical application of this fact, since the nature of the resemblances or differences between the two tasks would determine whether or not interference would develop between them (Chapter 20).

LEARNING BY WHOLES AND PARTS

Investigation of the learning of nonsense and sense material, poetry or prose, seems to favor the learning of material as a whole rather than in parts. If one had a poem of sixteen four-line verses to learn, the correct way to learn it would not be to learn it one verse at a time, a procedure commonly followed by an untrained individual, but to read from beginning to end again and again until the whole could be repeated. There is only one drawback to this method, namely that a person is likely to become discouraged or lose interest when progress is apparently lacking, if he does not have sufficient confidence in the method. It sometimes happens that, in first using this schedule of learning, rather poor results are obtained, but if given a fair trial the time saved and the greater permanence of the result will show its real efficiency.

The reason for the greater economy of the "whole method" is said to be found in one of the most fundamental laws of learning, that one should always begin by doing a thing as nearly as possible in the way it is eventually to be done. Otherwise, it must not only be relearned in part, but old habits must be broken. In learning anything in sections, associations are formed between the end of a section and its beginning, but since repetition as a whole is the desired end, all such associations must be finally broken and correct ones formed. Learning the task as a whole in the first place forms only habits that will be needed in the perfected performance. Allowances must be made to cover differences among individual preferences and attitudes, the length of the material, the degree of uniformity in difficulty within the material, and the pur-

poses to be served by the learned material. Nor is it certain that the laboratory findings are as applicable to the acquisition of complicated skills as they are to the process of memorizing. In any case the safest practical recommendation to make is to choose that method of learning that best suits the purpose rather than to apply a hard and fast rule. Children's learning should be supervised by those who can lay out the proper method for them.

ADJUSTMENT OF LEARNING TO USE

Emphasis upon practical considerations dictates freedom not merely in the choice of one or another method of learning, but in the degree to which learning shall be carried and in the form in which it shall be retained. Learning seems to most people to imply preparation for verbatim reproduction, which is a most exacting task, whereas the work of the world seldom demands that. There are occasions, to be sure, that require this type of learning, for example learning the multiplication tables and the spelling of words. But there are other kinds of material that should be accessible when required but that need not be carried in the mind at all times. In such cases one does not have to learn so completely that the facts may be recalled at any time, but only well enough so that they may be relearned easily when needed. Most of the knowledge acquired in school days has apparently gone completely from the mind, but only a small percentage of the original labor will bring it all back. Much of the education of the engineer, the professional man, and the teacher is of this kind.

There is a kind of material which need be learned only so well that it will be recalled along with some other definite thing with which it has been associated. The name of a person may be thus associated with the sight of his face, a telephone number with a particular name, a foreign word with the sight of the English equivalent. This type of memory calls for much less effort than absolute recall and in its place is just as efficient.

Some things need to be remembered only when they themselves are present. This form of memory is called recognition, and it is the most economical of all. It consists simply in knowing a thing or being familiar with it when we need it. For instance, it is far more important for one to know his fountain pen when he sees it, to be able to use it, than to know all about it at other times. In what way and how well a thing is to be learned must depend on the use that is to be made of it, for economy of effort demands that the means shall be employed that will be the most efficient and that will require the least expenditure of energy.

SIMPLIFICATION OF MATERIAL TO BE LEARNED

One of the greatest economies in learning comes from the adoption of simplified systems of material, such as spelling and measuring, in place of more complicated and unwieldy ones. It has been estimated (*209*), for example, that a system of simplified spelling would save approximately two years in the school life of a child. The value of a saving of this magnitude in terms of ability to read at an earlier age, of time available for other projects, and in terms of preparation for a life work shortened by two years, is difficult to compute. Gilbreth (*209*) promised even greater economies from the adoption of a simplified system of measurement such as the metric system. "Counting the English units bearing the same names as our own, we have in use four different sizes of pints, quarts, and gallons; three different sizes of gills; many sizes of barrels; and untold numbers of different sizes of bushels of things in different states, such as apples, potatoes, and the like; three kinds of ounces, drams, and pounds; two different sizes of hundredweight; four different tons; and two or three kinds of miles." It has been estimated that the United States spends unnecessarily each year 315 millions of dollars in teaching the old system of weights and measures and that a child of ten years who knows the decimal ratio can learn the essentials of the metric system in ten minutes. Similar economies could be attained in other directions if attention were addressed to gaining economy in learning, and with no decreased efficiency in other respects. Industry has achieved enormous economies by simplifying skilled operations and reducing them to standardized forms. What the efficiency engineer has done for mechanical work can be accomplished for the mental work of the child and the adult when the advantages of doing so are clearly understood. Any one who becomes thoroughly imbued with the idea of conserving human time and energy will go to the limit in advocating such radical innovations as a simplified universal language and a simplified universal calendar.

FORGETTING

Although learning and remembering are entitled to major interest and attention, one should not lose sight of the importance of forgetting. Much is learned for temporary use only, much is incorrectly learned and should be changed, much is experienced against the will and should be forgotten. It appears that time alone will not erase our memories whether they be good or bad.

Forgetting, thanks to Freud, has come to be looked upon as an active and not a passive process, an interference with connections

rather than a mere weakening of them with age. The long succession of researches into retroactive inhibition is interpreted in terms of the inhibitory effects of the newer upon the older. Besides this bare fact of interference is the discovery that its degree depends upon the qualitative relation of the new to the old—the greater the similarity, within certain limitations, the greater will be the interference (*339*) (*524*). Studies of the rate of forgetting during sleep furnish striking confirmation of forgetting as an active process, for it is found that a much smaller proportion of what is learned will be forgotten if learning is followed by sleep than if the learner remains awake (*657*). The practical rule to follow if one wanted to remember something just learned would be to learn it just before going to sleep, to follow it with a period of rest or with a very different kind of activity.

What should one do, on the other hand, if he wished to forget? The answer would seem to be that he should follow his learning with similar learning. But if he wished to forget immediately after learning, then, except in a laboratory experiment, he should not have learned at all. Obviously, the instances in which one wishes to forget in everyday life are very different from this. There the proper rule would seem to be to get new experiences, visit new scenes, form new associations. The more associations one has with a given idea or object or reaction, the less likely will any one of them be to come to mind, other things being equal. The device proposed by Dunlap (*150*) for breaking undesirable habits such as nail biting, typing errors, and the like would seem to be a contradiction not only of the statements just made but of all the facts of learning. He advocates the elimination of such habits by practising them, and reports success in dealing with particularly stubborn cases. His technique demonstrates the potency of the intention to learn as a necessary condition of learning, for he instills into his subjects the *intention not to learn.* It is the clear consciousness of the purpose of the repetition along with accessory reëducation that makes his method effective.

TRANSFER OF LEARNING

The practical outlook of this book makes it possible and advisable to pass over the earlier discussions concerning the transfer of training. Out of an active controversy covering many years there has evolved an attitude toward the problem which is healthful for both education and industry. Formal discipline in the early meaning of the term is advocated by few persons today. The opposing view that no transfer occurs from one situation to another except where identical elements are present in the two is softened by the recognition of the nature of such identical elements. There may be habits of looking for relationships, of

confidence in one's ability; there may be a knowledge of principles of good management; there may be a tendency to be alert; there may be a good emotional attitude or a successful technique. In every case of transfer there seems to be "something that you can put your finger on" (*715*, 362).

The most important point to remember is that the transfer of such elements is not a mystical process that occurs automatically. The relationships must be pointed out or detected; the applicability of the principles must be noted; the utility of the techniques must be discovered. It is the function of education, and of technical instruction in particular, to teach principles and techniques so as to make them transferable. Even with all the devices at the command of the teacher, the actual amount of transfer in education and industry is not very great (*257*).

A new approach to the whole problem of similarity of skills and of the feasibility of transferring workers from one skilled operation to another has come about through current techniques of occupational analysis (*27*). Attempts are being made to break down jobs into unit functions and to build up jobs into families according to the similarity of their units. These procedures are being worked out in the hope of readjusting large groups of competent workers who have been deprived of employment through technological changes. Of more remote utility are the encouraging efforts to apply the techniques of factor analysis to the breakdown of jobs into functional units. These topics will be dealt with more adequately in later chapters (Chapters 12 and 16).

5

Thinking and Suggestion

Habits, whether they are motor habits or habits of mind, have the character of routine implied in them. They have been developed in the course of a series of repeated reactions. Well-established habits closely resemble native responses, so much so that it is frequently difficult to distinguish between natural and acquired behavior. When a certain situation is presented, a series of habitual responses may occur in a seemingly automatic fashion. It is well that this is so, for such action is by far the most economical form of behavior. But all of our behavior cannot be of this routine sort. The human environment is so complicated that new and strange situations are sure to arise for which no habitual responses have been established. Thinking becomes necessary.

THE NATURE OF THINKING

When obstacles or difficulties interfere with the smooth flow of habits, some slight shift in the series of habits may be all that is necessary. But when no ready-made response is adequate, the human being is said to think, to reason, to judge what to do. A new adjustment to this strange situation must be created. It is the capacity for adjustment to a changing environment that is said to distinguish man most clearly from the animal. Whether this statement be strictly true or not, the thinking form of human reaction may be illustrated most readily by contrasting it with the behavior of an animal in a new and unusual situation.

When an animal is placed in one of the puzzle boxes used for studying learning, it attempts to escape by using many or all of its natural and learned reactions. These appear to be applied in a random, haphazard fashion, wrong movements being repeated again and again, until one movement or series of movements happens to meet the situation and makes escape possible. Or the animal may fail entirely to solve the problem. This form of behavior was described in the previous chapter under the name of "trial and error." When a human being is made

to face a similar problem, such as the need to escape from confinement, he may meet it just as the animal does, by "trial and error." Or he may use a kind of mental "trial and error," in which the various reactions are tried out in consciousness, the unsatisfactory responses being discarded before they become overt acts. The only overt motor response may be the one that correctly meets the conditions of the problem. The most striking difference that an observer would note in the behavior of the man and the animal would be the absence of motor manipulation in the case of the former. This case represents a kind of ideal fashion of solving a problem, for the customary difference would be that the human being makes relatively fewer and less random movements than the animal rather than none at all. In fact the study of human behavior in the presence of puzzling situations reveals instances ranging all the way from the animal method of attack to the relatively rare case such as is cited above (*152*). The majority of cases would fall somewhere between these two extremes.

In dealing with strictly mental problems where overt action is entirely absent or long delayed, the thinking process differs from the "trial-and-error" process mainly in the systematic character of the trials. That is, the wrong response is not repeated again and again as in animal learning, but when tried and found wrong it is permanently discarded. Thus the range of possible reactions is rapidly narrowed down until only the correct response remains.

Thinking, therefore, is not a unique mental operation differing from all others and superimposed upon them, but, on the contrary, partakes of the nature of the simpler forms of behavior. Hollingworth (*276*, 14), who approaches the problem of thought by way of sleeping and dreaming—with which it is usually sharply contrasted—says:

> In sleep thought ceases; in drowsiness, thought is seen making headway with the most meager equipment; in the dream the nature of thinking is so clearly exhibited that only waking reflection can rob dream verdicts of their coerciveness.

STAGES IN THE THINKING PROCESS

An examination of the mental trial-and-error process will reveal the conditions upon which effective and economical thinking depends. The following illustration cited by John Dewey (*133*) affords excellent material for this study. A certain individual crossing a river on a ferry-boat noticed a long pole painted white, bearing a gilded ball upon its end, and projecting nearly horizontally from the upper deck. At once a question arose in his mind, namely, what is the function of that pole? Possible answers to the question began to crowd into his mind—memories of earlier experiences of somewhat similar objects. Each an-

swer or suggestion was examined and tested in order to determine whether it was an adequate solution. These suggestions and the methods of trying them out were as follows:

1. It is a flagpole. The color of the pole, its shape, and the presence of the gilded ball upon its end made the suggestion of flagpole acceptable. But the position of the pole seemed to be a very unusual one for a flagpole. Furthermore, there was no visible means of attaching a flag to the pole, such as a ring, pulley, or even a cord. And finally, there were two other vertical poles, each carrying a flag. If this were a flagpole, it, too, would be bearing a flag This suggestion of flagpole as a solution of the problem was considered inadequate and was rejected.

2. It is an ornament. The general appearance of the object made this suggestion acceptable as it conformed to earlier experiences of ornaments. But memory and observation supplied the further information that all sorts of river craft carried the same kind of poles. Among these were tug-boats and freight boats which showed no other attempt at ornamentation. These objections were sufficient to overthrow the suggestion as a correct solution to the problem.

3 It is a radio antenna. Such terminals, however, usually occupy the highest available point and have wire attachments of some sort. There were no wires visible. In addition, there would seem to be no good reason for equipping all tugboats, ferry-boats, and other river craft with radios. Finally, memory supplied the information that boats carried this sort of pole before the radio was invented Therefore, this suggestion could not be accepted.

4. The pole might be a device to aid in steering the boat. In support of this suggestion it was noted that the pole was so located that the ball seemed to be projected in front of the pilot house where the pilot could easily see it. The pilot being located on the front of the boat would need some form of guide as to the direction in which it was traveling. Here is a device that might be used to guide the boat somewhat as the gunner uses his gun sight in order to aim. Thus its position could be accounted for As all boats would need some kind of aid in steering, the presence of such poles on all boats would be accounted for. The white color and the gilded ball on the end could be explained as a means of increasing the visibility of the steering device The suggestion that the pole was a steering device seemed to fit all the conditions of the problem and was consequently accepted as the correct solution.

THE DEMANDS OF CORRECT THINKING

This simple illustration of an ordinary adjustment to a strange situation contains all the elements of the thinking process.

1. First, a problem or difficulty must be clearly perceived. Where no problem is encountered there will be no thinking and the situation will be met with an habitual response. Where the problem is not clearly perceived the thinking will be erroneous. If it had not been observed that the pole lacked rope, ring, and pulley there might have been an immediate acceptance of the idea of flagpole.

Since thinking is difficult and since such a large proportion of our behavior is of the habit sort, there is a tendency to see no problems.

but rather to accept the first suggestion that occurs, or to interpret each new and strange experience as though it were an old one. It is a characteristic of some minds that they have a mental habit reaction for every new problem. Minds of this type are said to be in a rut. The social consequences of such a substitution of mental habit for thinking on the part of all people are elaborately set forth by James Harvey Robinson in his *Mind in the Making* (*527*).

It is not always mental laziness that is responsible for the failure to see problems. In many cases training is necessary. A scientific training is, in some measure at least, a training to see problems. The geologist is trained to see problems in rock formation, the botanist in flowers, the chemist in metals and soils that would escape any but such a trained observer.

2. Correct thinking implies a rich and varied experience out of which tentative answers may come. In the simple case cited, there were memories of flagpoles and their customary position and equipment; of decorative devices and where they are commonly used; of radio apparatus, its usual character and position, and the approximate time that the radio was invented.

> The curious mind is constantly alert and exploring, seeking material for thought, as a vigorous and healthy body is on the *qui vive* for nutriment. Such curiosity is the only sure guarantee of the acquisition of the primary facts upon which thinking must be based. The most casual notice of the activities of a young child reveals a ceaseless display of exploring and testing activity. Objects are sucked, fingered, and thumped; drawn and pushed, handled and thrown, in short, experimented with till they cease to yield new qualities. Such activities are hardly intellectual and yet without them intellectual activity would be feeble and intermittent through lack of stuff for its operation (*133,* 31).

The important part played by range of information in intelligence tests is justified since they serve as indicators of the presence of the stuff on which thinking must depend.

3. It is a fundamental condition of thinking that there must be a reservoir of past experiences, but even then the suggestions may not come forth from it. Their utilization will depend largely upon the systematic and orderly arrangement of one's memories. If, in the illustration given above, the previous experiences had not been recalled, thinking would have failed. Since all recall depends upon the functioning of associative mechanisms, the necessity of establishing numerous associations is apparent. Experiencing should be a process of assimilating, of relating new to old, of noting similarities and differences between new and old and not just a sponge-like soaking up of information. Each one of these operations means forming additional sets of associative connections which will increase the chances of recall in a variety of

circumstances. Unless one's memories are orderly and systematic and variously interrelated, one cannot be sure that all fruitful suggestions will be submitted for the solution of a problem.

Graham Wallas (*673*) has described the surprising fact about thinking, that solutions to problems frequently come when least expected, when no effort is being made to solve them, and when the problems themselves have been apparently forgotten. The happy suggestion may come during a ramble through the woods, during strenuous mountain climbing, in that hazy state of mind that occurs when one is about to fall asleep, or even in dreams. Thinkers vary in the means which they find most effective for encouraging and eliciting these "flashes" of thought. About all that one can do is to provide the circumstances that are known to be conducive to such flashes, to be prepared to recognize them when they come, and to record them before they fade away. After all the material bearing upon a problem has been absorbed, it is well to drop the matter, to rest from mental labor or to take up the solution of some other and entirely different problem, and accept the illumination when and if it comes.

4. Not every idea that flashes into the mind proves to be a correct answer, so that each one must be carefully tested to determine whether or not it satisfies the conditions of the problem. To withhold decision until all the evidence has been submitted and tested is often an irksome task. If in the above illustration the first, second, and third suggestions had not been carefully checked against observed facts, the conclusion would have been in error.

INDIVIDUAL DIFFERENCES IN THINKING

How shall one explain the great differences among people in their capacity to think and in the value of their thinking? The mind of the genius works much the same as the ordinary mind, and the steps in his reasoning are the same. There may, however, be differences within every stage of the process. One great difference appears in the number of suggestions that come to mind, owing to the varied relationships that are noted between the problem and previous experiences. The genius brings forth many recollections and "ideas" that would seem to the ordinary mind to have no connection whatever with the problem in hand.

Another difference has to do with the speed and facility with which the suggestions come. In some persons the suggestions come to mind with great rapidity and in others they come very slowly. On the whole, abundant and easily flowing suggestions are necessary to good thinking, but it sometimes happens that so many suggestions crowd into

the mind that there is an inability to select from among them and to try them out. There is such a condition in thinking as never being able to reach a conclusion because of the impossibility of giving all suggestions an adequate test. The best thinking results from neither too few nor too many suggestions.

The quality of the suggestions is more important than their number or the speed with which they are presented. Some suggestions may be extremely shallow and represent only the most superficial relationships, whereas others are fundamental and appropriate. The quality of the suggestions depends to a great degree upon the manner in which the material is originally experienced. If only superficial characteristics of a situation are perceived and made a part of one's mental stock, the suggestions coming therefrom will also be superficial. But if one's natural curiosity and training lead him carefully to analyze and examine facts as they are presented, the suggestions arising to meet problems will be not only more numerous but of greater value. Intuition, or insight, as the terms are popularly used, is probably nothing more than having only relevant and pertinent suggestions offered as material for meeting new and strange situations. Contrasted with intuition as thus defined are the ravings of the insane. Their ideas are the results of the functioning of associative mechanisms, but the associations are of the most superficial sort, frequently nothing more than connections based on word sounds. Such material is worse than useless, so far as correct thinking is concerned. Most people's thinking lies somewhere between these two extremes, where much material that is superficial and useless is recalled but is promptly rejected and not allowed to slow down the process of examining the relevant suggestions.

Finally, there are great differences in the care with which the suggestions are tested. Genius has been defined as the "capacity for taking infinite pains," and it is here that tedious and painstaking labor must be expended. It is said that great inventors have been known to try out systematically thousands of suggestions before finding a correct solution to some puzzling problem. In contrast to this is the ready acceptance of the first solution that old habits and attitudes of mind will suggest, which is characteristic of usual careless thinking. Careful and systematic examination of relevant ideas is at the bottom of most great achievements of thought.

THE BASIS OF OPINION

The need for a higher quality of thinking is everywhere evident. Our opinions, our beliefs, our judgments and convictions about matters of everyday life have been built up out of such a procedure as we have

described, sometimes more complicated in the number of suggestions that are offered and examined, and sometimes very much simplified and contracted in one or other of the stages leading to a conclusion. What chance is there that our opinions, thus formed, are sound? How can the serious-minded citizen be confident of the stand that he takes on prohibition, the platforms of political parties, a protective tariff, the League of Nations, and the other grave international questions about which every one is supposed to have an opinion? The answer to this question is of the gravest concern in a democracy where vital decisions on matters of policy are up to the people. The least that an intelligent individual can do is to check his opinions and attitudes by putting to himself the following queries:

1. Do I rightly understand the question?
2. Is my experience with the question sufficiently broad, as the result of reading or other contacts, to enable me to have fruitful suggestions or "ideas"?
3. Do the suggestions that occur to me exhaust the fund of my relevant experiences?
4. Have I thoroughly tested each suggestion in relation to the problem?

Only when an affirmative answer can be given to each of these questions can reliance be placed upon a conclusion. Opinions on most of the questions of the day cannot stand this searching examination. The proper attitude should then be that of open-mindedness, a willingness to wait for further evidence, rather than a final acceptance of one or the other point of view. Along with this there should go a recognition of the possibility of the appearance of new evidence which will require the readjustment of many well-established conclusions. The world of knowledge is constantly expanding and our opinions should be fluid enough to permit the changes that such growth entails.

RATIONALIZATION

Thinking is seldom a cold process of pure logic, but tends to be warmed by the trend of our desires. We *want* a preconceived solution to be the correct one. This undercurrent of desire may determine the course of thought at almost every stage. It may give a favored position to the suggestions leading toward the desired conclusion so far as recall is concerned, and may warp the testing of the suggestions so as to give undue weight to whatever will conform to desire. A case of such thinking known as *rationalization* is reported by Leuba (*373*, 127):

I know a laborer who is tormented by the desire to make money. Some time ago, he showed me a heavy mass of dark gray sand which he had extracted from the bottom of an old well He thought the sand contained gold, and had spent much time and money in order to establish the truth of his belief. A desire

for wealth was at the root of this man's conviction; but the desire alone would not have suggested the idea that the sand contained gold. It was of great weight and he had, moreover, observed in it brilliant yellow particles. Therefore, even though many reasons were urged against his conviction, he believed that he had found gold He did not, of course, rest content at this point He wanted a scientific demonstration of the truth of his belief, and accordingly he had the sand analyzed. When a reliable chemist reported the absence of gold, he placed samples in other hands. Despite several concordant negative analyses, this man has not yet altogether given up hope.

Lund (*389*) has gathered spectacular evidence of the degree to which people's current beliefs are related to their desires. He took a series of statements ranging from those that are accepted as axiomatic to those that have a peculiarly personal quality. These statements were rated in three ways, according to the degree to which they were believed, the degree to which they were supported by evidence, and the degree to which they were desired by the raters. When the correlation technique was applied to the three arrangements of the statements, it was found that the correlation between belief and evidence was +.42, that between desire and belief was +.88, and that between desire and evidence was —.03. Although one is not safe in inferring causal relations from correlation coefficients, the presumption is that one tends to believe what one wants to believe.

SUGGESTION

It was pointed out above that thinking is difficult and laborious and that it is used only when necessary to overcome obstacles that cannot be met by means of an habitual response. Rationalization has been described as a short cut to a solution. There is one other way of avoiding the rigors of thinking that consists in accepting, without critical examination, the conclusions of some other person. This response commonly occurs when an opinion has been expressed by one who is considered an authority, as a teacher, preacher, or public speaker, or where it is printed in a book or newspaper. Although in many instances of no great importance it may be advisable to accept the opinions of others without testing them, it is a bad mental habit to do so generally. Authorities have been known to be wrong and much that is printed and spoken cannot be considered authoritative.

Suggestion is the term usually applied to the uncritical acceptance of an idea coming from another person. And people are said to be more or less suggestible according to the degree to which they are governed by the ideas of others.

Suggestion may be looked upon as a force to be guarded against or as a force to be employed. If one wishes to guarantee that his own

behavior shall be as effective as possible, he will choose the former attitude; whereas if he happens to be especially interested in controlling the behavior of others, he will choose the latter attitude. Applied psychology should offer the material necessary for satisfying either demand.

CONDITIONS FAVORING SUGGESTIBILITY

The so-called laws of suggestion which state the conditions under which suggestion may be most forcefully used, will, if thoroughly understood, serve both as an aid in the use of suggestion and as a protection against it. It is true, however, that most interest has been directed toward the former of these functions. For example, suggestion as a means of increasing the efficiency of the salesman has been widely exploited. No corresponding attention has been given to the protection of the potential purchaser against the influence of the salesman.

The most important facts about suggestion are the following:

1. The suggestion should be indirect, that is, it should seem to arise spontaneously within the mind of the individual and not to come from another. Few persons are willing to have their ideas and actions completely under the control of another person and will on that account alone often resist suggestions when they are made too bluntly. Suggestion is most effective when used to strengthen ideas already present, but which are prevented from leading to action on account of the presence of other conflicting ideas. In such cases the one idea may be strengthened sufficiently to lead to action without opposition. This is very much easier than implanting entirely new ideas. The following cases described by Sidis (*566*, 7) are good examples of indirect suggestion:

> A stump orator mounts a log or a car and begins to harangue the crowd. In the grossest way he praises the great intelligence, the brave spirit of the people, the virtue of the citizens, glibly telling his audience that with such genius as they possess they must see clearly that the prosperity of the country depends on the politics he favors, on the party whose valiant champion he now is His argument is absurd, his motive is contemptible, and still as a rule he carries the body of the crowd.

> A huckster stations himself in the middle of the street, on some public square, or on the sidewalk and begins to pour forth volumes of gibberish intended both as a compliment to the people and as praise of his ware. The curiosity of the passers-by is awakened. They stop. Soon our hero forms the center of a crowd that stupidly gazes at the "wonderful" objects held out to its view for admiration. A few moments more and the crowd begins to buy the things the huckster suggests as grand, beautiful and cheap.

2. There must be a high degree of attention to the idea that is suggested. This is much the same as the earlier statement that there must be no conflicting ideas if a given idea is to lead to action. A high degree of attention to an idea may be obtained by the removal of distracting conditions of all sorts. It may be accomplished by restricting bodily movements with the consequent reduction in the stream of sensations therefrom or by reducing the number of stimuli of the special senses, especially of vision and hearing. The favorable conditions for inducing that extreme state of suggestibility known as hypnotism (*298*) are the darkened room, the crystal ball, the regularly beating metronome, and the rhythmic stroking of the arm or head. One reason which has been offered for the great suggestibility of persons in a crowd is the restriction of bodily movement caused by the massing of the people. Recent research into mob behavior (*423*) has shown, however, that it is an extremely complicated pattern of reaction and not to be explained by any simple formula.

3. The success of a suggestion depends upon its source. Prestige and authority are great factors in giving strength to a suggestion (*375*). The mere fact that some one in authority or one in whom we have great confidence does a thing is sufficient to give the suggestion of it great power. Thus, we are likely to follow the leaders in fashion, in politics, in all social manners and customs through the intensity of the indirect suggestions coming from these sources. A powerful factor in selling certain kinds of goods is the suggestion that the article is used by the President of the United States, by the King of England, that it is manufactured by the largest firm in the United States, or by the oldest firm, although none of these factors is in itself any real guarantee of the value of the commodity. In the suggestive power of prestige and reputation lies much of the power of great evangelists, great orators and entertainers. The prestige of the radio was beautifully demonstrated by the reactions of thousands of people to the Martian broadcasts, the "War of the Worlds" (*81*), when their fears could have been immediately allayed by reference to the radio programs in their daily papers.

4. The force of a suggestion depends in part upon the frequency with which it is applied. Repetition tends not only to increase the strength of the suggestion by driving out competing ideas, but tends also to make the suggestion seem spontaneous. In the course of the repetition, consciousness of the external origin of the suggested idea is lost. Many a person has denied that he is influenced by advertising in the purchasing of foods and other necessities, and yet a canvass of these purchases shows that a large proportion of them are of the most widely advertised and trade-marked goods. It is very likely that advertising of

the publicity sort met on every hand has much to do with the inability of people to account correctly for the disposition to buy certain brands of goods rather than others. Repetition is said to be a favored device of the political dictators in forcing acceptance of their ideas.

5. Positive suggestions are more effective than negative suggestions. It is more effective to say, "Do this," than it is to say, "Do not do that." Ideas tend more directly to the production than to the inhibition of action. There is a strong tendency to react to suggestion in the positive fashion no matter how it may be presented. This is well illustrated in the story many times repeated of the man who offered a large money prize to any person who could fry an egg and while doing so refrain from repeating to himself the word hippopotamus. No one ever succeeded in winning the prize, for the negative suggestion guarantees the positive reaction. The relative value of positive and negative suggestion has been much discussed in connection with advertising appeals (*387*), whereas the growing belief in the efficacy of positive suggestion is reflected in the striking decrease in the use of negative suggestions in advertising during the last two decades.

6. Cantril (*82*) points out still another condition favoring suggestibility which is found in the state of confusion existing in the minds of people regarding questions of social philosophy. Confused and bewildered persons whose foundations of belief are badly shaken and who need enlightenment and guidance will tend to accept them uncritically from any promising source. By playing upon conditions of mind such as these, dictators have risen to power.

INDIVIDUAL DIFFERENCES IN SUGGESTIBILITY

Numerous experiments have been devised for measuring suggestibility (*479*) (*701*), and attention has been directed thereby to the question of individual differences in this trait. One very definite conclusion has been reached, namely, that people cannot be classed into suggestible and non-suggestible groups. This trait is possessed in varying degrees just as intelligence is found to be distributed among the population. Furthermore, it has been found that a person who is very suggestible in one situation is not necessarily suggestible in another situation (*63*). It would seem that there are many suggestibilities rather than a single trait of suggestibility. As age increases it has been found that suggestibility tends to decrease. The exact relationship between intelligence and suggestibility is not known, but it is likely that there is at least a slight negative correlation between these two characteristics in the individual. As far as sex differences are concerned, no clear-cut differences between men and women have been discovered. Suggestion

is a most powerful factor in those individuals who cannot or do not think for themselves. Waves of certain types of crime, waves of suicide by peculiar means, waves of kidnapping, waves of mania for dancing, and waves of style are in part at least to be explained by the power of suggestion upon certain types of mind.

CROWD SUGGESTIBILITY

The suggestibility of people, when gathered into crowds, follows the same laws as that of the individual taken alone, but susceptibility to suggestion seems to increase in a crowd. There appears to be less resistance to suggested ideas and less repugnance toward being swayed by others. The conflicting ideas that help to determine the course of action in any one person taken alone are submerged in the group. Or, as one writer has aptly put it, "The intensity of personality is in inverse proportion to the number of aggregated men." Sidis (*566,* 300) thus describes the suggestibility of the crowd:

> There is a gradual limitation of voluntary movement, a condition of monotony and inhibition with a consequent contraction of the field of conciousness. When a preacher, politician, the stump orator, the ringleader, the hero, gains the ear of the crowd, an ominous silence frequently characterized as awful sets in. The crowd is in a state of overstrained expectation; with suspended breath it watches the hero or the interesting, all-absorbing object. Disturbing impressions are excluded, put down, driven away by main force. So great is the silence induced in the fascinated crowd, that very frequently the buzzing of a fly or even the drop of a pin can be distinctly heard. All interfering impressions and ideas are inhibited.

By referring to the conditions of suggestibility previously mentioned it will be seen that here is an ideal setting for powerful suggestions to become effective. Often individuals are horrified at what they did as members of a mob. Religious revivals, political meetings, strike riots, and lynchings are all illustrations of what individuals, when collected into a large group and under the influence of strong suggestion, will do. Cantril (*82*) has furnished excellent descriptions of the patterns of mass action in a variety of settings, including lynchings, religious cults, social utopias, and great political movements.

PROPAGANDA

The topic of propaganda deserves space in any chapter dealing with the control of ideas, not so much because it is a unique phenomenon but because it represents a deliberate, systematic, and organized large-scale effort to control public opinion. When subjected to psychological

analysis, skilful propaganda is seen to rest upon the full utilization of the facts of suggestion and suggestibility such as have been discussed in this chapter. Its current potency is due not to the discovery of new principles but to the universality of the radio and motion picture, the public-opinion poll, and other means of rapid and widespread communication by way of which ideas may be disseminated and their influence gauged. The present state of social unrest is undoubtedly a contributing factor, heightening suggestibility, but whether this unrest is cause or effect of the power of propaganda is not so easy to determine.

What is it that distinguishes propaganda from education, publicity, news, or advertising? Lasswell (*365*) and his associates attempt to discriminate among these terms. Education is defined by them as a process of transmitting skills and *accepted* attitudes, whereas propaganda is a process of transmitting attitudes that are recognized as *controversial* within a given community. This is, indeed, a tenuous and variable distinction. Identical ideas spread at one time and place may be education, and at another time and place may be propaganda. The authors just mentioned say that the inculcation of respect for Martin Luther in a devout Prussian village is a process of education in terms of the village, but a process of propaganda in terms of the whole of Germany or of the world. To the casual onlooker upon the current social scene, the most obvious distinction between education and propaganda resides in the greater zeal, enthusiasm, and vigor with which the propagandists prosecute their program. Education in its process of spreading accepted views might learn much from those who endeavor to teach controversial ideas.

Social psychologists have been actively interested in the conditions which favor the inculcation of attitudes as contrasted with the educators who have till recent years concerned themselves with the teaching of mental and motor skills. The development of techniques for measuring attitudes in the form of tests and scales has been followed by a succession of studies of the relative effectiveness of the spoken and printed word, of the speaking person as compared with a recording of his speech, of the influence of age, degree of education, family background, economic and social status upon attitude change. Murphy, Murphy, and Newcomb (*449*) have made this material accessible to the reader in an extensive survey.

These brief comments upon propaganda may be closed with the observation that the mechanisms and processes that have been described in this and the preceding chapter can be enlisted equally well in the cause of education and in the cause of propaganda, in the cause of changing attitudes and in the cause of developing resistance to such changes.

6

Work and Rest

Work and fatigue resulting from work come close to the daily life of every one. As a consequence they were among the earliest problems to be investigated by the physiologist and the psychologist. The concern of the psychologist has been indicated on several occasions in the preceding chapters. He has had to deal with fatigability as a possible source of differences in achievement between the sexes; he has had to look for fatigue effects in the quality and quantity of learning under various conditions; and more generally still he has been led to search for methods of work in which the fatigue would be the least. In doing these things he has accepted more or less directly the layman's notion of fatigue. The layman has no rigid definition, but he *knows* what fatigue is and believes that he regulates his behavior so as to avoid it or recover from it when it cannot be avoided. He knows that fatigue is "being tired" and that when one is tired the proper thing to do is to rest. Such a meaning is satisfactory and safe under ordinary circumstances, particularly where there is no urge "to make the most of oneself." However, when pressure for increased output is exerted as in a war emergency, then doubts begin to arise because sometimes one feels tired when he has done no work at all, and sometimes he does not feel tired after a long period of work. He discovers, too, that the tired feeling occasionally disappears in the course of work instead of becoming more pronounced as it should.

THE CONCEPTS OF WORK AND FATIGUE

The foregoing statements suggest the need for a definition of the terms work and fatigue, if confusion is to be avoided. This is especially true of the former where a variety of meanings can be detected in everyday usage. For instance, work may mean a certain product such as a cord of wood sawed, a mountain climbed, or a chapter of a book written, and it may mean the process by which these results were achieved. Thus one may do a great deal of work without accomplishing much,

when sawing wood with a dull saw, or when struggling to write a chapter when the "conditions are not right." Work defined as product also has a variety of meanings. There seems to be a distinction on the basis of utility such that if the product is useful it is called work, if it is not useful it is called "play" (*77*). Similarly, one can detect a distinction on the basis of necessity, work being that which is necessary and play that which is not necessary. There is a further common notion that work is necessarily unpleasant, whereas play is by its very nature pleasant.

Even when work is defined as process or function the meaning is not entirely unequivocal. In fact the meanings in terms of output have equivalent meanings in terms of function. *Doing* something necessary is work and *doing* something unnecessary is play. There is the tendency, too, to think of the work process as limited to that which leads to the desired or useful product. Thus in an experiment on a finger ergograph the rhythmic contractions of the finger that raise the weight are work, but there are contractions and tensions of other muscles which are just as real work so far as the organism is concerned.

The most serious source of confusion for both scientist and layman resides in the distinction between physical work and mental work. And this distinction appears in work conceived as product and as process. Physical work is thought of as something like pounds lifted, the result of the contraction of muscle and the movement of bones. Mental work is less tangible, like solutions to problems, and involves the functioning of the mind or perhaps the brain. The distinction is frequently drawn between solving a problem which is mental work and writing down the answer or speaking it, which is physical work. Benedict and Carpenter (*35*) measured the mental work done in taking an examination by deducting from the total energy expended in the process the amount that was later expended in just copying the examination paper as previously written. This residue was the cost of the pure mental-work process.

It may be convenient to use the terms mental and physical in reference to product. In terms of process, however, it would appear to be less confusing to classify work in terms of the amount of overt muscular activity involved such as heavy, medium, and light, or general and local. For research has demonstrated that even the purest thinking may be correlated with incipient speech movements, and that "mental images" may be recorded in terms of muscle tensions (*553a*). The acceptable scientific procedure would be to describe the task, the process, and the product and avoid such labels as work and play, mental and physical.

Most of the definitions of fatigue that have been proposed have been

derived from common-sense notions, and emphasize one or another aspect of them. One rather widely accepted definition is that fatigue is the reduction in the output of work as the result of work, and which is recoverable by rest. In this particular definition the feelings of tiredness are not mentioned, but in others they have been recognized as potent factors in determining output of work. Thus Woodworth (*713*) said:

> Every one who has worked with the ergograph has certainly felt these sensations. Every one recognizes that their tendency is to check contractions Every one must have noticed the difficulty, amounting in untrained subjects to impossibility, of resisting this tendency. Yet few have recognized the sensations of fatigue as an actual factor in the determinations of the rate of fatigue.

Dodge (*140*), likewise, felt that feelings had a place in the concept of fatigue in that they acted as warning signals against overexercise of delicate mechanisms.

The lack of correlation between changes in output of work and changes in the feelings, along with other inconsistencies in definition, led Muscio (*454*) to reëxamine thoroughly the whole concept of fatigue. He gave expression to a point of view which has had a pronounced effect upon subsequent thinking and research. Starting with the widely accepted definition of fatigue as "a condition caused by work in which the capacity for work is diminished," he revised it at once by substituting the word "activity" for work, since, as he said, play as well as work may conceivably cause fatigue. His definition thus became: "Fatigue is a condition caused by activity in which the capacity for repeating the activity that caused it is diminished." He then noted that capacity for activity cannot be directly observed, but must be inferred from some expression of it. The most obvious expression would be output of work and a less obvious one perhaps would be feelings. But is output a valid expression of capacity? Dodge had shown that output, at least within certain limits, is a function of the intensity of the stimulus, citing the changes in performance due to motivation in the form of incentives. He had shown also, and again within certain limits, that output is a function of the intensity of motivation toward competing kinds of activity, citing in this case the effects of distractions upon output. Hence, Muscio concluded that, at best, output only *tends* to be an expression of diminished capacity when there are no interfering factors. He arrived at a final definition as follows: "Fatigue is a condition caused by activity in which output produced by that activity tends to be relatively poor; and the degree of fatigue tends to vary directly with poorness of output." This definition he considered inadequate and scientifically unsatisfactory for two reasons. The first is that

fatigue can never be directly measured but is a condition which must be *inferred* from diminished capacity, whereas diminished capacity itself must in turn be *inferred* from diminished output. The second reason is that the inference of diminished capacity from diminished output is insecure since the latter is known to depend upon a variety of influences such as distraction and motivation. Muscio concluded that the concept of fatigue had lost its utility by reason of its very remoteness from reality.

THE EFFECTS OF WORK

After making a critical examination of these and other difficulties inherent in the various interpretations of fatigue, Muscio recommended that the concept of fatigue be banished from precise scientific discussion, and that in its stead attempts should be made to measure the effects of work directly upon mental and physiological functions without the intermediary notion of fatigue. Although this recommendation implies primarily a shift of emphasis, it is a healthful one in that it forces attention upon the psychophysical mechanism of work and the changes which it undergoes while functioning. When the changes become known, and ready means of measuring their amount become available, the practical problem of efficient work will be easy of solution. The relative extent of the changes during different work conditions will show which ones of such conditions are the most favorable for work.

The functions in which changes may be sought as a consequence of work are numerous and varied. Although a complete account of the effects of work would call for the measurement of all of these functions, data on only one or several may be adequate for the solution of a particular practical problem. The functions whose changes have been measured or proposed for measurement at one time or another are output of work, strength, feelings, energy cost, pulse, blood pressure, weight, skin sensitivity, sensory acuity, and perceptual reactions. The point to note is that each or all of these should be measured for what the evidence would be worth rather than to provide the means of inferring a condition of fatigue. Thus at a time when high output is vital, that method of work could be sought in which the initial output was highest and the decrement from continuing it the least. It is conceivable that at another period, as in a time of labor unrest, the matter of most concern would be to find that method of work in which the feelings would be the least outraged. Or at still another period, as in a time of extreme food shortage, the important thing might be to get work done with the least expenditure of energy. Finally, it might well

be that changes in the circulatory functions would be the most significant effects to search out if one were measuring the cost of work in conditions of extreme heat as in a boiler room. A knowledge of the correlations among these various measures would be of immense scientific and practical interest. If the correlations were very high one measure could serve as an indicator of the others, but even if the correlations were unknown or were known to be low, each measure could serve its own independent purpose. Some of these more common measures will be examined.

EFFECTS OF WORK UPON SENSITIVITY

Several tests of bodily sensitivity have been used from time to time as indicators of a change of condition during work. Underlying their use was the expectation that there should be a general decrement resulting from work, and that the sensitive receptor mechanisms should be progressively dulled. Notable among the sensitivity tests was the two-point threshold test or the esthesiometric index (*701*, I, *243-261*), as it was called, to detect changes in discriminative power of the skin. It was widely employed at one time as a means of showing the fatigue of school children and for classifying them according to their endurance. The test was thought to be an indirect measure of sustained attention, a function that ought to undergo a decrement in the course of work. After years of controversy over the question the test has been recognized to be so influenced by innumerable variables that it is no longer employed as an index of the effects of work. Since changes in the function itself have no practical utility no further attention need be given it here.

Visual acuity is another form of sensitivity that has been suggested from time to time as a useful index of change as a result of work. Requiring a high degree of fineness of muscular control, it might be expected to undergo deterioration during a period of work. Thus far no studies have definitely shown this to be the case. As the visual acuity test is usually administered, it suffers from the defect that it calls for only a momentary effort to which an individual can rise even under very adverse conditions. A more appropriate measure would be something like that employed by Ferree and Rand (*174*) in which the maintenance of maximal acuity was determined over a period of three minutes. The visual acuity test deserves further consideration since it measures a function which has direct utility. This is especially true where, as in aviation, a high degree of visual capacity is of great importance, and where at the same time work under strain might be expected to create some decrement. In fact Ferree and Rand (*173*)

have offered speed of accommodation for near and distant objects as a measure of fatigue of aviators.

Sensitivity of the skin to faradic stimulation is another measure that has been employed as an indicator of the state of the organism. An irritability curve covering a number of persons measured over a twelve-hour period by Grabfield and Martin (*226*) shows periods of high irritability (low threshold) between 10 and 11 A.M., and at 8:30 P.M., with a period of low irritability at about 4:30 P.M. This curve is reported to correspond very closely in its general features to curves for a series of ergograms and for a series of reaction times taken at various periods of the day. Large ergographic output and short reaction times corresponded to low threshold. The authors believed that the irritability index was not a measure merely of peripheral sensitivity but was an indicator of the general nervous condition of the subject. The test itself is subject to all the difficulties inherent in threshold measurement, particularly momentary fluctuations in attention, and is therefore not very feasible for detecting the more gradual changes that might be expected to occur in the course of work.

THE EFFECTS OF WORK UPON MUSCULAR STRENGTH

The Martin Strength Test (*400*) measures the amount of traction that certain muscle groups can resist. The test has been used primarily for determining standards of strength required for certain kinds of industrial work, but its author says:

> Variations of strength between the beginning and the end of a working period, particularly if they take the direction of a falling off at the end of the shift, are indicative of an impairment of physique which can be most readily explained on the basis of fatigue.

Table 12 gives a few sample figures showing percentage of change in strength as the result of a day's work of different sorts. There are two kinds of work, heavy and light, represented in the table, as well as two groups of workers, strong and weak, as measured by the strength tests. Plus signs mean increase in strength and minus signs mean decrease in strength. The table shows that heavy work causes a greater percentage of loss in strength than light work, and also that strong individuals suffer less than weak ones. It will be noticed that the strong group of workers increased their strength in one of the heavy tasks and in both of the light tasks, and that the weak group increased their strength in both the light tasks. There has been an inclination to doubt the value of a test for measuring physiological changes during work which shows an actual improvement after the "expenditure of

much energy." Muscio (*455*) criticized the test because of the errors to which it is liable when administered under factory conditions and by different testers. A further criticism resides in the fact that the test calls for a momentary resistance to tension, and that the brief bursts of power needed in such a case may be possible even for a tired muscle group. However, the measurement would be warranted in so far as such strength as the test measures is a condition that might have utility on any given occasion.

TABLE 12

CHANGES IN STRENGTH DURING WORK *

Operation	*Per Cent Change*	
	Strong	Weak
Heavy—Swaging valves	0 00	— 4.60
Brazing heavy parts. .	+ 1 00	— 6 00
Light—Milling machine	+ 3 20	+ 0 68
Drilling and burring. . .	+ 5.00	+ 1.60

* From E G Martin, "Strength Tests in Industry," United States Public Health Service Report, No. 606, 1920

EFFECTS OF WORK UPON ATTENTION CONTROL

It has been pointed out by numerous investigators that work involving a high degree of attention is likely to be more fatiguing than that which demands merely strength or speed. There are other reasons for believing, too, that attention is a highly sensitive barometer of general mental and physical efficiency. It was such a belief, in part at least, which led to the use of the various sensitivity tests mentioned above, since sensory thresholds were known to be affected by degree of attention. It is not surprising, therefore, that an effort should be made to find a direct measure of attention to replace the more indirect ones. Reversals of visual perspective, such as occur in looking at simple drawings of cubes and staircases, have been thought to be a function of attention, and these have been measured as indicators of shifting attention. According to Carr (*88, 282*) these reversals "occur automatically and spontaneously even though one perspective may be the preferred one and in spite of any experimental or volitional control."

Ash (*17*) set up a reversible perspective test for measuring the fatigue caused by arithmetical computation. The speed of reversal for cubes and pyramids was measured before and after one hour of computation in the case of twenty-one subjects, one and a half hours for three subjects, and two hours for one subject. For this last subject the reversal time was longer after the work by 26 per cent, 51 per cent, and 104 per

cent for the one-hour, the one and one-half-hour, and the two-hour work periods respectively. For the three subjects who worked for one and for one and one-half hours the average delay was 39 per cent and 53.6 per cent respectively, although one of these subjects showed greater delay for the shorter period. For the twenty-one subjects who worked only one hour, the average delay varied from 9 per cent to 146 per cent, with an average of 50 per cent. There was no instance in which the speed of reversal was greater after work than before.

Poffenberger * repeated the visual-perspective test, as used by Ash, before and after physical work performed on devices of the ergograph type, involving either the hand, the arm, the leg, or the whole body as in rowing. In every type of work the combined records for all subjects showed fewer reversals after work than before work. However, the differences are too small and the variability too great to make the results anything more than suggestive. Thus, in the data for the leg work comprising eighty-six different measures and showing an average of 8.7 per cent fewer reversals after work, there were fifty individual cases of "slower after work" and thirty-six of "faster after work." Serious difficulties have been encountered in the practical administration of the test, as it requires well-trained subjects to get satisfactory results. One difficulty arises from the difference between voluntary and spontaneous reversals as pointed out by Hollingworth (*273*) since the effects of continued work seem to decrease speed of reversal in the former and to increase it in the latter.

EFFECTS OF WORK UPON MOTOR CONTROL

The fineness of motor control or coördination is such an essential factor in many forms of adjustment as to justify a search for its decrement in the course of work. This is particularly true in industrial operations where heavy labor has been so largely replaced by rapid movements of small muscles, and where slight deviations from proper control may result in serious error or accident. Ash (*17*) acted upon an observation made by McDougall (*406*) that in the use of a finger ergograph the fingers not immediately concerned in the lifting begin to respond as the contractions of the working finger grows weaker. As the work progresses the muscles of the wrist, arm, shoulder, and even of the face and neck become involved.

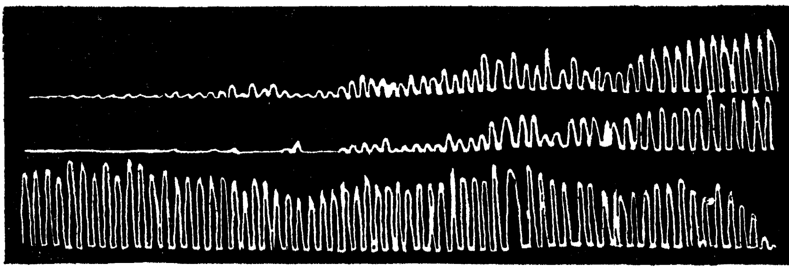
These accessory responses indicate a spread or overflow of excitation out of the immediately appropriate channels. Ash attempted to measure this spread of activity in the course of work. He modified the usual

* Unpublished.

Mosso finger ergograph so that while the middle finger was attached to a weight of 13.2 pounds, the first and third fingers which are ordinarily held rigid were attached to springs of known tension. As the middle finger lifted the weight any movements of the first and third

FIGURE 25

THE EFFECT OF WORK UPON MOTOR CONTROL *



* From I. E. Ash, "Fatigue and Its Effect upon Control," *Arch. Psychol.* (New York, 1914, No. 31, 19.

fingers would pull against the springs. Kymograph records were made of the movement of all three fingers and the amount of work done by each was calculated. Such a set of curves is shown in Figure 25, where *C* represents the middle finger lifting the weight, *B* the third finger, and *A* the index finger. Table 13 shows the foot-pounds of work

TABLE 13

SPREAD OF MOTOR RESPONSE IN THE COURSE OF WORK *

Foot-Pounds of Work in Successive Groups of Five Lifts

Groups of Five Contractions	I *Index Finger*	II *Middle Finger*	III *Third Finger*	IV *Sum of Index and Third Fingers*
1	.00	5 30	.00	.00
2	.00	5 50	.03	.03
3	.00	5.30	.11	.11
4	.01	4.81	29	.30
5	.07	4 12	.17	.24
6	.07	3.78	.36	.43
7	.21	4 54	.52	.73
8	.29	4 88	.70	.99
9	.92	5.15	1.20	1 92
10	.53	4.40	1 01	1.54
11	1.19	3 85	1.01	1.20
12	1.79	4.33	2 23	4.12
13	2.11	1.36	1.82	3.93

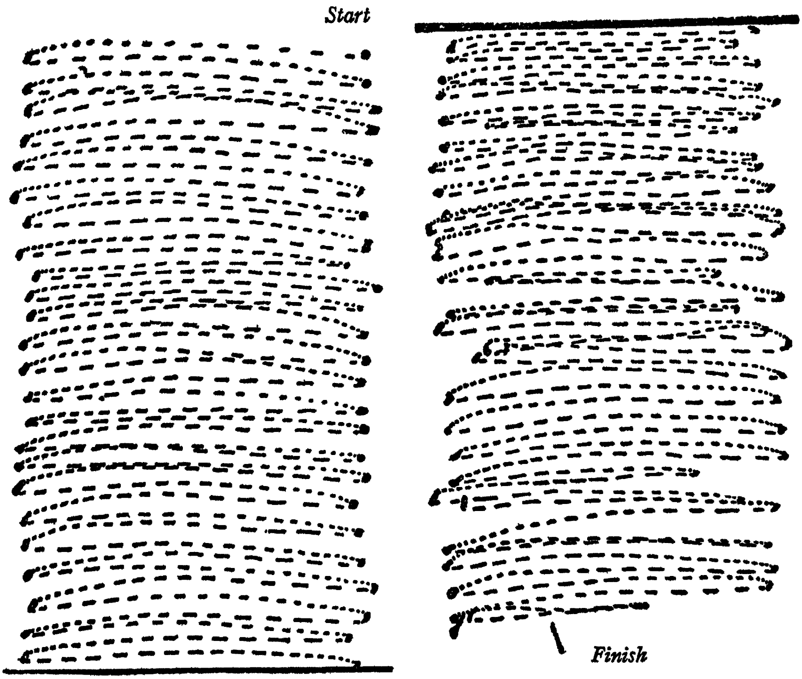
* From I. E. Ash, "Fatigue and Its Effect upon Control," *Arch. Psychol.* (New York), 1914, *31*, 22

done in groups of five contractions. Column I is the index finger, Column II is the middle finger, and Column III is the third finger. Column IV gives the sum of the work done by the first and third fingers. It may be noted from both the chart and the table that the spread of movement to the "non-working" fingers begins very early and is noticeable earlier than the reduction of output in the working finger.

Dodge (*140*) disclosed the increasing loss of motor control in a succession of rhythmic eye movements. The eyes, each with its set of

FIGURE 26

EFFECTS OF WORK UPON EYE-MOVEMENT CONTROL *



* From R Dodge, "The Laws of Relative Fatigue," *Psychol. Rev*, 1917, *24*, 107.

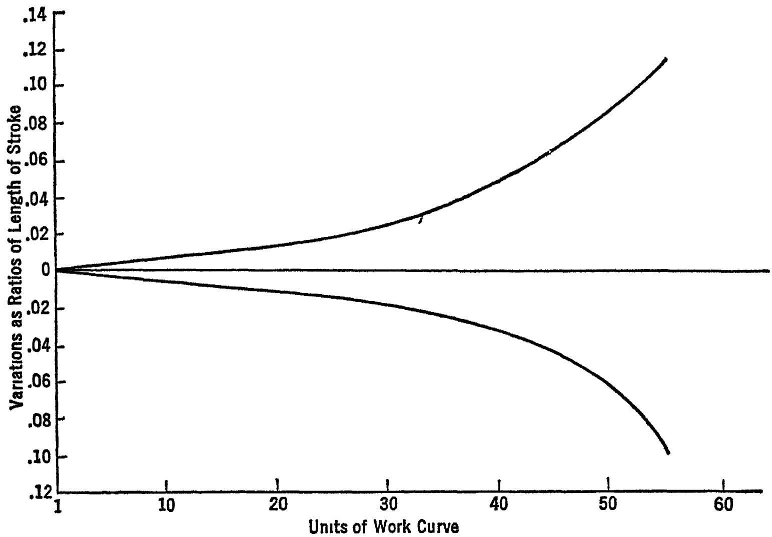
six external muscles, constitute an exceedingly sensitive and finely balanced coördinating mechanism. Any decrement in control should show itself in the character of the eye movements. Dodge instructed his subjects to shift their eyes rhythmically from one fixation point to another over an angle of 60 degrees, and photographed the series of movements upon a falling plate. Such a photographic record is reproduced in Figure 26, where the dash lines mark the sweep of the eyes back and forth, and where each dash and each space equals an interval of .008 second. In the early part of the record the curves are smooth

and of uniform length and the dashes evenly distributed, indicating that the fixations are accurate and the speed of movement steady. The latter part of the record, on the other hand, shows increasingly faulty fixations, varying rates of speed, and unevenness of the paths traversed. All of these changes are indications of a deterioration in control which Dodge attributes to a central rather than a peripheral factor, since in binocular reactions the two eyes respond in the same way.

Weinland (*687*) attempted to follow the course of the variability of performance in the usual type of ergograph curve, obtained from the

FIGURE 27

VARIABILITY OF PERFORMANCE IN THE WORK CURVE *



* Modified from J D Weinland, "Variability of Performance in the Curve of Work," *Arch. Psychol.* (New York), 1927, No. 87, 23.

finger, arm, hand, leg, and the body as a whole (rowing). He had available the records of ten subjects, each furnishing a number of ergograms whose general form is shown in Fig. 89. Of the several types of variation in performance, he was particularly interested in the changes in output from moment to moment of the work period. He corrected for the increase in variability due to the gradual fall in the level of the curve by computing the variations of the individual contractions above and below a smoothed curve. Figure 27 presents a chart showing in terms of percentages the course of the deviations thus computed for an arm raising a twelve-pound weight at a two-second rhythm and continuing till the weight could no longer be moved. The vertical scale shows the percentage of change from the smoothed curve taken as zero,

and the horizontal scale marks the successive units of the ergogram. The variation increases from zero at the beginning and may amount to as much as 20 per cent for some individuals at the end. The fluctuations are undoubtedly due to irregularity of motor control rather than to the condition of the muscle. The pattern of variation changes with the individual and with the particular kind of movement, although "the degree of variability within the work curve appears to remain comparatively constant for a given individual under particular working conditions." The steadiness of tempo of reaction was also found to vary in the course of work. It need scarcely be pointed out that fluctuations in motor control of the magnitude recorded in this experiment, accompanied by variations in movement rhythm, might have serious repercussions upon achievement. The size of the differences in variability among individuals, which would be expected and which were noted in this experiment, suggest the probable importance of selection for stability of motor control.

The concept of blocking in the course of continued work has been developed by Bills (*39*), and many of his experiments with such functions as color naming, naming opposites, addition, and subtraction seem to support his view. Blockings are "brief periods when the subject is unable to react at all and must pause an instant before proceeding." He seeks the explanation for the blocks in the "cumulative refractory periods" of the functioning neural units, a theory of mental fatigue earlier proposed by Dodge (*140*) and elaborated by Robinson (*521*).

The point of particular interest is that the blockings are reported to occur more frequently and to become longer as work continues. Although these inert periods demonstrated by Bills are so brief and occur so frequently that they would not be readily detectable in the course of everyday activities, they represent a type of loss of control. If they were to become more and more persistent in the course of long-continued repetitive work, they would have to be reckoned with as a factor in efficient performance. Search might well be made for evidence of such loss of control in operations resembling more closely the activities of everyday life.

EFFECTS OF WORK UPON THE FEELINGS

The discrepancy between the way one feels and the amount of work he is able to do is a matter of common knowledge. Its influence upon the formulation of concepts of work and fatigue has already been mentioned. The changes which the feelings undergo during work deserve careful examination both as possible signs of capacity to work and as indicators in their own right of the effect of work.

Thorndike (*619*) had five persons judge the quality of compositions continuously for four hours. Every twenty minutes during this period each person evaluated his feelings on a ten-point scale ranging from extreme distaste or discomfort to extreme interest, zeal, or satisfaction. He reports that whereas output remained substantially the same in quantity and quality, the satisfyingness decreased greatly. "These facts support the general doctrine that the effect of lack of rest is far greater upon whatever is the physiological basis of interest, willingness, or tolerability than upon the physiological basis of quantity and quality of product produced."

Poffenberger (*499*) obtained substantially the same results when he computed the averages for ten to thirteen subjects working at four different kinds of tasks, equivalent forms of an intelligence examination, sentence completion, judging compositions, and addition. The work continued for approximately five and one-half hours, except for addition where the time was less. The total time was divided into units of approximately twenty minutes. At the beginning of the experiment and at the end of each unit, the feelings were evaluated on a scale of seven degrees, varying from (1) Extremely good to (7) Extremely tired. At the end of the fourteenth unit of work a rest period of ten minutes was introduced, at the termination of which the final unit of work was completed. The data for this whole experiment are presented graphically in Figure 28. Solid lines show output and broken lines show feelings. The output curves are plotted in terms of ratios of the initial score taken as 1.00 (left-hand vertical scale), and the feeling curves are plotted in terms of units of the scale above or below the initial feeling score which is taken as zero (right-hand vertical scale).

In every type of work these average curves show a considerable drop in the quality of feelings, regardless of the course of the output curves. It will be noted that the tasks differ markedly so far as output changes are concerned, ranging from a gain of 20 per cent in the intelligence tests (obviously practice effect), to addition with a loss of about 20 per cent; completion and the judgment of compositions remaining almost unchanged. The greatest change in the feelings occurs in the completion test in which output does not fall. One further fact should be noted, that the ten-minute rest improved the quality of the feelings by one scale unit or more, regardless of whether the output improved or not.

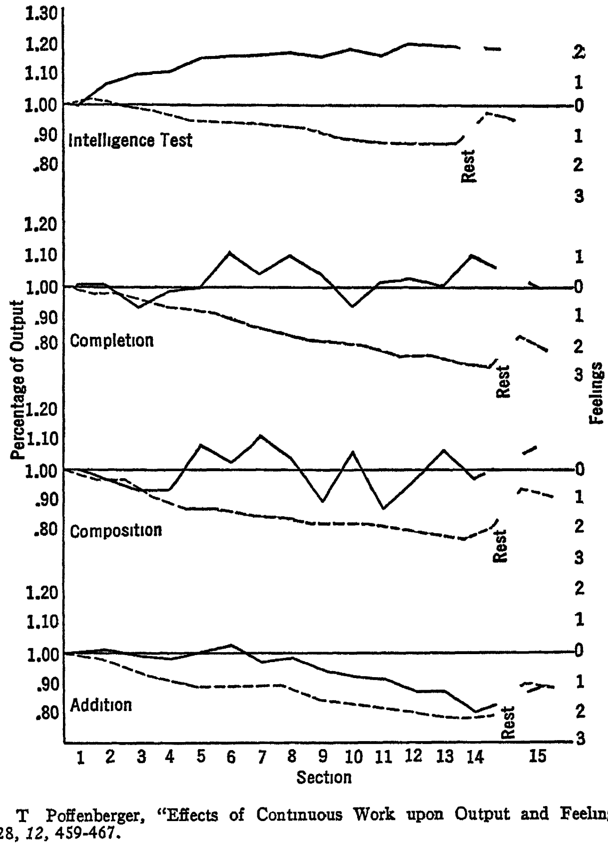
An inspection of the separate curves of output and of feelings for each individual provide one additional bit of suggestive information. In the intelligence test the subject who made the greatest gain in output had the least decrement in his feelings, whereas the one who made the least gain in output had the greatest decrement in feelings. The

same is true in the case of the addition test. These facts are shown graphically in Figure 29 where the solid line represents output and the broken line represents feelings.

FIGURE 28

Relation Between Output and Feelings in Four Forms of Mental Work *

Solid Line Represents Output and Dotted Line Represents Feeling Record



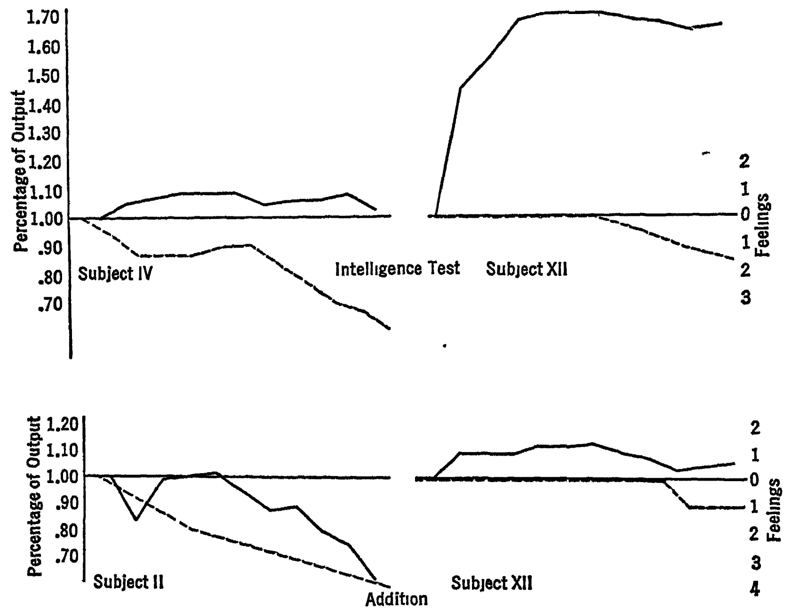
* From A T Poffenberger, "Effects of Continuous Work upon Output and Feelings," *J. App. Psychol*, 1928, *12*, 459-467.

In order to discover whether the relationship between amount of loss in output and in feelings shown in these two extreme cases would hold more generally, the four subjects showing the greatest loss of output were compared with the four showing the least output in regard to the amount of feeling change. The former dropped 2.0 scale units of feeling and the latter 1.25 units in the intelligence test; and the former dropped 3.25 units, and the latter dropped 1.25 units in the

addition test. With so few cases it is futile to compute the reliability of these differences, but the results do suggest that those persons who lose most in output may be the ones who will be expected to experience the greatest change in feelings and vice versa.

FIGURE 29

RELATIONSHIP BETWEEN AMOUNT OF CHANGE IN OUTPUT AND AMOUNT OF CHANGE IN FEELINGS *



* From A T. Poffenberger, "Effects of Continuous Work upon Output and Feelings," *J. Appl. Psychol*, 1928, *12*, 459-467.

As suggested in the beginning of this chapter, changes in the feeling level may be a significant item of information, entirely aside from any relationship such a measure may have with quality or quantity of output. Other things being equal, that type of work, length of work spell, distribution of rest periods, or condition of noise or of quiet which outrages the feelings the least would be the best one.

EFFECTS OF WORK UPON RATE OF RECOVERY

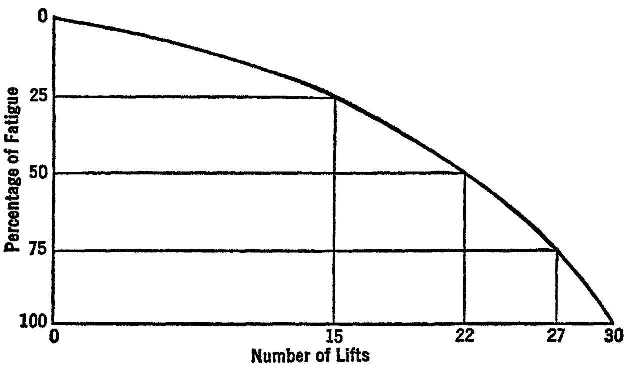
The effects of work may very well show themselves not so much in terms of amount produced as in terms of the time that is required to recover from a spell of work, or the degree to which recovery occurs in a standard time interval. Thus in a standardized type of work whose

rhythm is specified by the speed of a machine or of a moving belt, the effects may appear in a failure to recover from a night's rest.

Mosso (*440*) in one of his early ergograph experiments found that, with a given load to be lifted, the finger became exhausted after lifting the weight thirty times. Complete recovery from this work required two hours of rest. When the work was stopped after the weight had been lifted only fifteen times, complete recovery was attained in only a half hour. Thus the recovery time is reduced to one-fourth by reducing the number of lifts onè half. From these simple facts a hypothetical recovery curve can be constructed as shown in Figure 30. The horizontal scale indicates the number of lifts, whereas the vertical scale indicates

FIGURE 30

RATE OF FATIGUE DURING WORK



the percentage of time required to recover from complete exhaustion (percentage of fatigue), zero being at the top of the scale and 100 per cent at the bottom of the scale. It appears that it took four times as long to recover from the second half of the work (the second fifteen lifts of the weight) as from the first half (the first fifteen lifts of the weight). It appears also that the last three lifts cost as much in time required for recovery as the first fifteen lifts. If recovery time be taken as the measure of efficiency, then carrying work to the limit of exhaustion would be uneconomical because the last few units of work would be too costly. On the other hand, the introduction of a half hour of rest would always keep the worker in that part of his curve where the cost per lift would be the least. The problem of efficient work reduces, therefore, to keeping the worker in the efficient part of his curve through the introduction of rest, adjustment of load, and so forth.

Crawley (*121*) measured the effects of work under varying conditions upon the degree of recovery during a standardized rest period and

found that increasing output in a given work period would, under certain circumstances, be reflected in a decreased output after rest. Figure 89, page 408, shows a pair of ergograms taken before and after a rest of four minutes when the arm was lifting rhythmically a load of fifteen pounds. Since under the conditions of the experiment the output should be the same after rest as before it, the decrement in the second work period is attributed to failure to recover completely during the rest. The cumulative effect of a work and rest schedule which does not allow for complete recovery from any one work period is clearly shown in the curves obtained by Manzer (*394*). Work spells of rhythmical lifting by the arm of a 13.6 kilogram load until exhaustion,

TABLE 14

RECOVERY FROM WORK *

	Original	After Rest		
		5 min	10 min.	20 min.
Finger	100	83	86	100
Hand	100	82	90	95
Arm	100	90	98	99
Leg	100	85	100	103
Rowing	100	72	75	77
Average	100	82	90	95

* From C W. Manzer, "An Experimental Study of Rest Pauses," *Arch Psychol.* (New York), 1927, *90*, 29.

repeated fourteen times with a rest period of two minutes between work spells, furnished one of the curves of Figure 94, page 423. Since all should have been the same as the first one except for the failure to recover from preceding work periods, the cumulative loss throughout the series is obvious.

The degree of recovery and, conversely, the degree of failure to recover from various kinds of work with different rest intervals between work periods is shown in Table 14, which is also derived from Manzer. The work performed by a number of subjects was all of the ergograph type involving either the finger, hand, arm, leg, or the whole body (as in rowing). The rest intervals were five, ten, and twenty minutes in length. In each case the work done is expressed in percentages of the first work period which is taken as 100 per cent. It will be seen from this table that a five-minute rest did not bring about complete recovery in any type of work, but that ten minutes was adequate for recovery of

the leg and twenty minutes for recovery of the finger. Rowing showed the least recovery after every rest period.

Sufficient evidence has been given to show that the effect of kind and quantity of work may be detected in terms of time required to recover or the amount recovered in a given time. The techniques employed in these studies are not appropriate for field studies, but they offer the sort of evidence from which a scientific study of work and rest programs could well begin. Here the conditions were set so as to bring out effects in terms of recovery. In everyday life the loss per unit of work or per day might be so small as to be undetected, and yet the cumulative effect of months or years might assume disturbing proportions. Some of the series of ergograms obtained by Manzer (Figure 94) showed no unrecovered effect in the second and even in the third ergogram, but in the tenth the effect was unmistakable.

EFFECTS OF WORK UPON METABOLISM

If one looks upon the human organism as a machine and its functioning as a process which transforms energy, then the work that it performs can be measured directly in terms of such energy transformation, which is known as metabolism. The unit of measure generally employed for expressing the rate of the metabolic process is the *calory,* which is a heat unit. It denotes the amount of heat necessary to raise one gram of water one degree centigrade. As the amount of heat needed to do this is very small, a unit 1,000 times as large and known as the *large calory* is commonly used. It denotes the amount of heat needed to raise the temperature of a kilogram of water one degree centigrade. Thus the energy that the human body has to expend in performing any sort of task could be measured in terms of calories, and the differences in energy cost between various work programs could be measured in the same way.

The direct determination of the amount of energy liberated by way of the heat generated is laborious and cumbersome, as it requires the subject to be confined in an elaborate calorimeter chamber. Fortunately, a substitute measure is available in terms of the oxygen which the body extracts from the air that it breathes. The energy releasing process is an oxidation process in which a kind of fuel, presumably glycogen, is burned and heat generated. Now this combustion process requires oxygen and the amount of it that is needed to release a unit of energy has been computed. Thus, as stated by Hill (*259*), one liter of oxygen is required to produce 5.14 calories (large) or, roughly, a fifth of a liter of oxygen is needed to produce one calory of energy. Fortunately, also, the human body has no facilities for the storage of oxygen

which may be drawn upon as needed, so that the amount used has to be promptly replaced by extracting it from the inspired air. It is possible, therefore, to measure the amount of energy used in work even over a short period of time, by determining the amount of oxygen used. There are numerous ways of doing this, each with its own advantages and disadvantages. The method which has the greatest flexibility and which allows the greatest freedom of movement while the measurements are being made, is illustrated in Figure 31, taken from Hill's study referred to above (*259*, 9). The subject inspires atmospheric air whose constitution is known and is remarkably stable. His expired air is captured in a suitable container. When the composition of this expired air is determined and compared with the inspired air, the changes which it has undergone can be computed. Atmospheric air has the following components:

	Per Cent
Oxygen	20 93
Carbon dioxide	0 03
Nitrogen	79 04

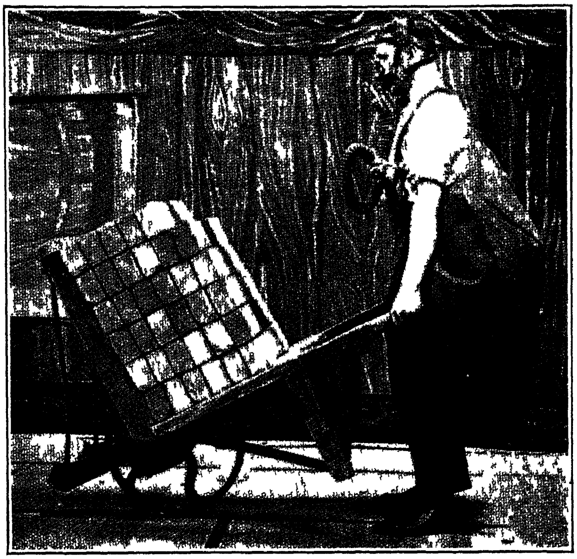
If the expired air turned out to be;

	Per Cent
Oxygen	16 93
Carbon dioxide	4 03
Nitrogen	79 04

then 4 per cent of the oxygen would have been used; and if the total quantity of the air expired was known, the actual amount of oxygen could be found. It will be noted that the amount of carbon dioxide has increased in this illustration by 4 per cent. The amount of carbon dioxide, too, could be used as an index of energy. However, it has one disadvantage which offsets certain advantages, namely, that the body can store large quantities of carbon dioxide; hence one cannot tell just how the amount released is related to the amount produced during a given time interval. The illustration shows a bag strapped upon the worker's back, and a mask covering his nose and mouth. Flexible rubber tubing leads from the mask to the bag, and contains a valve permitting passage of air into the bag but not in the reverse direction. The mask also contains an opening to the outside air, and is fitted with a valve so that air may enter but not leave the mask thereby. Thus the expired air accumulates in the bag. There remains only the process of analyzing this expired air, measuring its amount, and computing the change. This is a laborious process, but it can be accomplished under ordinary working conditions with an estimated error of 1 per cent. How extensively this measure of the effects of work

FIGURE 31

THE MEASUREMENT OF ENERGY EXPENDITURE DURING WORK *



* From A V Hill, *Muscular Movement in Man* (New York, McGraw-Hill Book Co, 1927), p 9

has been used in recent years is indicated in the survey of the literature on the subject up to 1932 by Page (*480*) whose annotated bibliography contains 625 references.

The energy expended in various forms of human locomotion is shown in Table 15 which is compiled from data of Hill, Long, and Lupton (*260*), and Douglas and Priestley (*144a*). The first column of figures gives the speed of travel in miles per hour; the second gives the cubic centimeters of oxygen consumed per minute; and the third gives the

TABLE 15

ENERGY EXPENDED IN HUMAN LOCOMOTION

Activity	*cc of O_2 per Minute*	*c.c of O_2 per Mile*
Lying down in post-absorptive state	237	.....
Standing still	328	.....
Walking 1 66 m p h	606	21816
2 00 m p h.	668	20040
3.00 m p h	907	18140
4 00 m.p h	1182	17730
5.00 m p h	2125	25500
Running 6.50 m p h	2868	26472
7 50 m p h	3395	27160
9.00 m p.h.	3834	25534
10 00 m p h.	3910	23460

amount consumed per mile of travel. All the figures are rough estimates and not all the data are taken from the same subjects, so that too much importance should not be attached to small differences. However the table shows that the energy measure is sensitive enough to pick up differences in cost resulting from variations in performance of work.

Schubert (*541*) attempted to measure the metabolic cost of a unit of work at various stages of the work curve, somewhat as Mosso did in terms of recovery time (p. 113). Among the many obstacles that he encountered was his inability to stabilize sufficiently the output curve over a succession of work periods to make possible the comparisons of the cost of different quarters of it. To meet the difficulty he chose such a load to be lifted and a rhythm for lifting that the output remained uniform throughout the work period. That is, the work curve approximated a straight horizontal line. He then looked for evidence of changed efficiency only in the cost per unit of work. But the work conditions that gave a uniform output were also the conditions that enabled the worker to maintain a "steady state" so far as expenditure of energy was concerned. The only evidence of changing cost that he

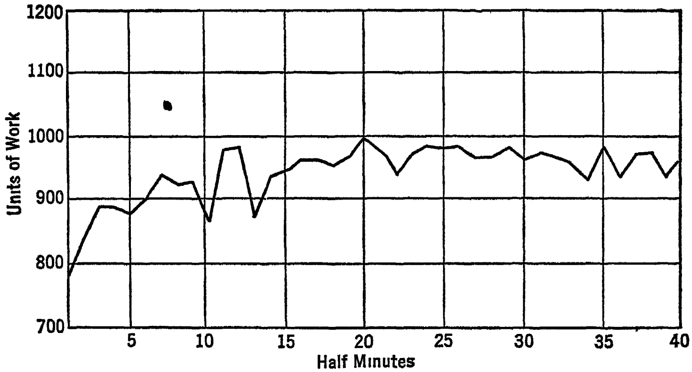
could detect was in the slightly longer period required to return to the resting metabolic rate from work done in the latter stages of the curve. This problem that Schubert attacked is sufficiently important to warrant a modified attack upon it. The field study by Waller reported on pages 422-423 suggests that the unit cost of the work should increase in the later stages of the work period.

EFFECTS OF WORK UPON OUTPUT

The most commonly used measure of the effects of work and the one which has the most immediate utility is the amount of work done. The objective of work is to produce something, whether it be a formula from the thinking of the mathematician or an automobile part from

FIGURE 32

WARMING-UP PHENOMENON *



* Adapted from E. S. Robinson and W. T. Heron, "The Warming-Up Effect," *J. Exp. Psychol.*, 1924, *7*, 81.

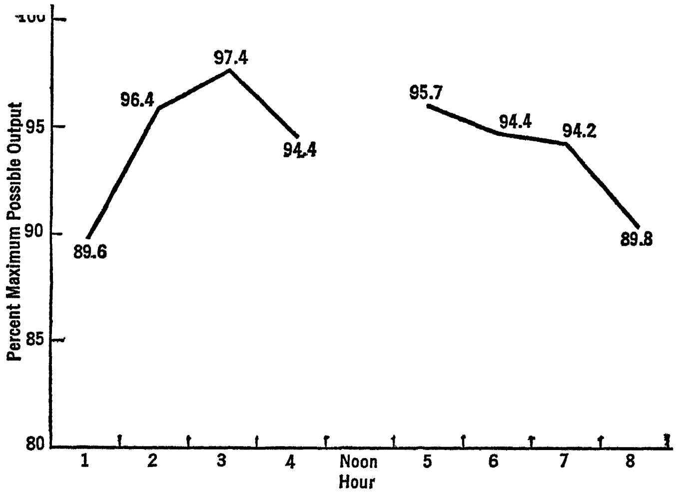
the worker in industry. However, the earlier parts of this chapter and later chapters (Chapters 23 and 24) show that other effects cannot be entirely neglected.

The effect of work is not always and necessarily a decrement in output. Laboratory studies of the work process usually do show such a decrement but that is because conditions are deliberately arranged to produce it. Thus ergograms generally show a progressive loss because the load to be lifted and the frequency of lifts are set so as to show a decrement within a convenient time interval, since the investigator is interested in decrement. Even under such circumstances there is frequently an early stage of the work curve which shows an increase in output. This is known as the warming-up period. It is clearly indicated in Figure 32, which is the work curve for a very simple task

from a study by Robinson and Heron (*526*). Here the influence of practice, which might well cause such an increase, has been eliminated. The vertical scale shows the units of work done, and the horizontal scale shows the consecutive half-minute units of the work period. The maximal rate of work was not reached until the end of sixteen such units. The work begins to decrease in quantity at about the twenty-sixth half-minute. Work curves obtained from industry and covering periods as long as a half-day or a day show similar initial increase in output. This is particularly clear in Figure 33 (*219*), which

FIGURE 33

OUTPUT CURVE FOR MEDIUM-HEAVY WORK DURING AN EIGHT-HOUR DAY *



* Adapted from *Public Health Service Bulletin, U. S. Pub Health Service,* 1920, No. 106, 74.

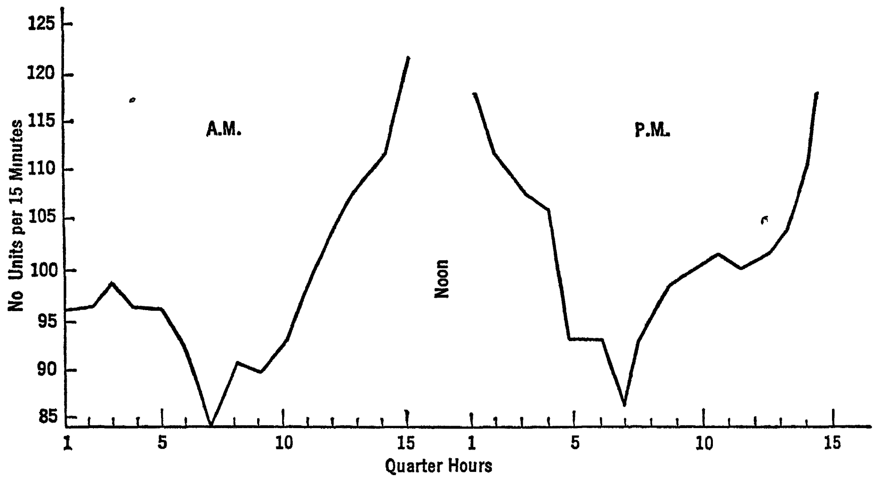
is a composite curve for medium-heavy machine work and in which output is expressed in terms of the percentage of the maximum of which the plant is capable. It will be observed that the high point of output for the day is not reached until the third hour of the morning. Although other factors than mere warming up are undoubtedly at work in such instances, that, too, contributes something to the total effect.

The work curves just mentioned, which portray the course of output for moderately heavy work, do show a decrement over the course of the whole work period such that the final hour may be as much as 10 to 15 per cent below the maximum. But not all work curves show such loss. In fact work curves for light, high-speed operations may portray a pattern just the reverse of these. For instance, the curves

shown in Figure 34, taken from Wyatt (*724*), tend to have their high points at the beginning and end of the period with a low level of output somewhere between these extremes.

FIGURE 34

OUTPUT CURVE FOR SEVEN-AND-ONE-HALF-HOUR DAY—LIGHT WORK *



* Adapted from S. Wyatt, "Incentives in Repetitive Work," *Industr Hlth Res. Bd Rep.*, 1934, No. 69, 18

INDIVIDUAL DIFFERENCES IN CAPACITY FOR CONTINUOUS WORK

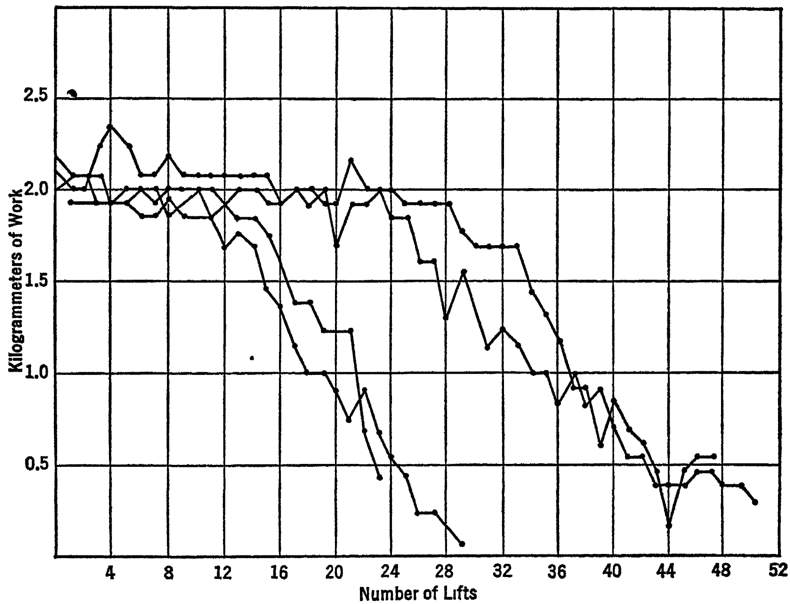
It is natural that people should differ markedly in their capacity for continued work, since the work process is found to involve so many of the bodily functions, each of which varies in efficiency from individual to individual. The range of individual differences is as great in respect to work as in any other where measurements are available. Some persons seem able to maintain a work schedule that would be impossible for others. There are individuals who become exhausted after taking a few steps and who figure prominently in psychopathology. Figure 35 presents the work curves of four men who lifted a 24-pound weight every two seconds by bending the arm at the elbow, each one continuing the work as long as he could The vertical scale shows kilogrammeters of work done at each lift, and the horizontal scale indicates the number of separate lifts. Although the four began at about the same level of performance the best one did more than twice as much work as the others. All the men were in good health and had some previous training in the work. Strength, undoubtedly,

is an important factor in such a performance as this, yet many other factors, some of them mental, play an important part.

In comparing the efficiency of individuals it is well to remember that there is useless as well as useful work, and that some persons do much more useless work per unit of useful work than others. As far as energy is concerned, the useless work is just as costly as the useful.

FIGURE 35

INDIVIDUAL DIFFERENCES IN OUTPUT OF WORK



The person who worries or is otherwise emotionally upset, who works under high tension, who fidgets or keeps his whole musculature under strain while at work expends his energy needlessly. In selecting persons for a given type of work, therefore, it is not enough to determine the soundness and strength of the working parts, but it is necessary also to know something about their habits of work.

PRONENESS TO ACCIDENT

An individual peculiarity that has come to attract unusually wide attention is the proneness to accident. It has, indeed, become customary to speak of "accident prone" automobile drivers (*44*) (*167*), meaning

roughly those who have two to three times as many accidents as the average driver. The use of the term need not, however, be restricted to automobile accidents for it covers equally well the accident repeaters in industry. It will be futile to seek for any single cause for the behavior of such individuals, although the hypothesis of Drake (*146*) is worth thorough testing in that it has the support of common sense. It is that individuals whose level of muscular reaction is above their level of perception are prone to more frequent and more severe accidents than are those individuals whose muscular reactions are below their perceptual level. In other words, the person who reacts quicker than he can perceive is more likely to have accidents than is the person who can perceive more quickly than he can act. Bingham (*44*) presumes a native factor to be found in mental dullness, emotional instability, and defects in the special sensory and motor mechanisms. He mentions also temporary conditions such as illness, lack of sleep, fatigue, worry, and anxiety leading to absent-mindedness. The data that have been reported on the effects of continuous work upon motor control would lead one to expect increasing accident rate with increasing duration of work. And the additional fact of individual differences would lead one to expect great variability in the effect of work upon the control needed for avoidance of accidents. Properly controlled research should be able to tease out the effect of this so-called fatigue factor, and to determine its relative importance among other contributary circumstances.

REST

Continuous activity has been found to affect certain functions in the direction of a lowered level of achievement, interpreting the term achievement very broadly. Under properly controlled conditions output is reduced, satisfaction is diminished, and motor control is less adequate. The data presented in this chapter show, too, that where these effects of continuous work obtain, rest will tend to restore the achievement to its pre-work level. This statement holds for output, feelings, and accuracy of control.

One further assertion is commonly made, although it is less firmly established in evidence from research, namely that the more complete the rest the more thorough is the recovery. Recovery from the effects of work would, then, be most rapid and complete during a period of absolute inactivity. Such a state, however, can only be approximated but never attained since there is activity of some degree during every waking moment (*342*). Many of the muscles of the body are active, if in no other way than in supporting the body's weight. Consequently,

all rest might be conceived as a change of activity in the direction of a reduced amount. Even during sleep there is not perfect rest, as the body movements and dream activity clearly show.

Kleitman, Cooperman, and Mullin (*343*) have obtained records of normal sleepers by means of an elaborate recording system attached to a bed. They found normal subjects to make from thirty to sixty shifts of positions per night, with a period of about thirty seconds of activity per hour in units of five to ten seconds. These results confirm the earlier figures of Johnson (*326*). It will be granted, nevertheless, that sleep approaches more nearly to complete rest than does the normal waking state. It should be noted incidentally that Jacobson (*311*) finds it entirely feasible to establish in the waking individual a state of relaxation approximating that of sleep. Individuals differ in the ease with which they can induce the state of relaxation in themselves, but apparently it can be learned by any one who will practise according to the program of Jacobson.

The effects of rest may be taken at their face value or an attempt can be made to explain them. If this is done the explanation may be made on one or another level, psychological, physiological, or chemical. It is usual to explain them on the physiological level and to consider sleep as the phenomenon to be studied as it represents the maximal resting state.

Practically all the physiological theories of sleep attribute its onset either to a diminution of available energy-producing materials or to an accumulation of the waste products of metabolism. The actual state of unconsciousness is variously accounted for (*342*). Studies that have been made of circulatory processes during sleep support the view that it is a period of repair. For instance, Shepard (*560*) found that the amount of blood in the cerebral blood vessels increased during sleep, suggesting the probability that the increased circulation makes for the effective repair of brain tissue.

According to the waste and repair theory the amount of rest (sleep) that is needed would be a function of the amount of waste. This should differ not only with the kind and amount of the work done, but with the individual. Some persons seem to preserve the balance between waste and repair more perfectly than others, hence they need less rest and sleep. Thus rest periods in the midst of work to be most effective must be adjusted to the work and to the individual.

7

The Effects of Distraction upon Achievement: Noise

The behavior of living organisms cannot be considered apart from the environment in which their reactions occur. Native endowment and training up to the moment of action lay the conditions and predispose for certain kinds of behavior, but the particular quality and amount of reaction that actually occurs depend upon the interaction of these forces. Environment is here used in a very broad sense and includes the envelope of air surrounding the body, as well as its clothing, the quality and quantity of the illumination, natural or artificial. It includes the individual's human and animal neighbors and all the stimuli that are playing upon his special senses. The list is, consequently, extremely long, although the influence of many items in the list is too slight to be of practical importance. It is essential, however, to go beyond the general notion that some environmental factors are good or bad, and to find out to just what degree one's daily work and play are affected by them, and just which ones are vital enough to warrant efforts toward their control in particular circumstances. The search for means of increasing efficiency in business, in industry, and in the public schools, and for means of raising the level of general health and comfort has led to the investigation of some of these environmental forces, with interesting results. Noises, smoke, gasoline fumes, quality, quantity, and sources of light, temperature and humidity, the rhythmical alternation of day and night, and many others are objects of attack in research laboratories and in the field. Some of the more important of these conditions will be examined in this and the succeeding chapters.

ATTENTION AND DISTRACTION

Distraction should be thought of as a form of attention. In every waking moment something is being attended to. And at every moment there is a great variety of objects competing for attention. These are

facts resting upon the nature of the inherited sensory and motor mechanisms. It is equally natural that only one of these objects or a limited group of them should be attended to at one time and that attention should tend to shift from one of them to another. The objects which can be attended to are of the most varied sort. They may be experienced by way of the distance receptors, the eye, the ear, and the nose, the sights, sounds, and odors of everyday life; or they may be objects in contact with the body, thus affecting the receptors in the mouth, skin, the muscles, and internal organs, bringing tastes, experiences of warmth and cold, contact of clothing, pains, sense of movement, and fatigue; or they may be memories or products of the imagination.

Attention, by its derivation, means "to be drawn to" or "to be attracted to." Out of all the complex of objects exerting their attracting power, one or a few of them will be the most effective and will be attended to. All the others then become potential distractors of the attention, in that they tend to draw the attention toward themselves. Thus, what is at one moment the object of attention may at another be a distractor. There is, therefore, no real difference between "attractors" and "distractors." The distinction usually made is a kind of utilitarian one, namely that those objects that attract attention when one wants to or ought to be attending to something else are distractors. For example, when I ought to be studying, my neighbor's good music is a distraction. When I want to read, the bright light on the wall is a distraction. But both the music and the light may cease to distract me and begin to attract me when I intend to pay attention to them. When at work at a rapidly moving and dangerous cutting machine, I may be distracted by memories of a foolish mistake of the evening before, or by the imagination of myself speeding over country roads in an automobile that I can never afford to purchase. A kind of moral distinction is also sometimes made between what I want to attend to and what I ought to attend to. The former are distractors and the latter attractors. It is not always safe, therefore, to think of distractors as unpleasant or undesirable from the point of view of the individual affected. Although it is necessary to understand these essential characteristics of distractions, it will suffice for the present to list as distractors only those objects, feelings, memories, and ideas which tend to interfere with work.

This struggle for attention implies more than a mere subjective conflict. Attention is inseparably bound up with adjusting movements and tensions that involve not only the muscles regulating the sense organs, but also the voluntary musculature, as indicated by respiratory, circulatory, and other organic reactions. Such muscular responses consume energy and lead to strain and weariness just like any other kind

of muscular work. In fact the conflict between antagonistic muscle groups is especially likely to lead to such effects because the parts are under a constant tension, even when no overt movement occurs. For example, if a flickering light source lies within the field of vision while one is reading, one set of muscles tends to turn the eyes toward the light and another tends to draw them in the opposite direction. In such a case the eyes may remain adjusted to the book, but the muscles will be under constant tension. Accurate measurement might, in this case, show an unsteadiness of the eyes owing to the fluctuations in the success of the conflict. Tensions in other voluntary muscles are usually present and seem to give aid in directing the attention. Although evidence of such conflict is particularly clear in the case of vision (Chapter 8) it is, nevertheless, present in attention to any class of stimuli.

If the average person were to be asked whether or not distractions of any sort are advantageous, his reply would most likely be that they are not, for the term distraction implies an interference or disturbance. Evidence could be adduced of the disturbing effects upon efficient work of an aching corn, an itching nose, an ill-fitting collar, a broken finger nail, the hum of conversation, or the rattle of a typewriter. Still, there is the opposite view popularly expressed in the saying that "a dog without fleas would die," and the testimony of persons who seem either entirely unaffected or even benefited by a limited amount of distraction. At the present time when a search is being made for causes of inefficiency, and when business offices are filled with clicking typewriters, when industrial plants are resounding with the noise of huge machines, and the streets are filled with the sounds of traffic, the question of the real effect of distractions is worthy of careful study. Whether the distractions be great or small, the problem remains the same, namely, are distractions harmful and if so, why?

ADJUSTMENT OF EFFORT TO TASK

Experimental studies have tended to minimize the influence of most kinds of distraction. This conclusion has been reached by measurements of work products obtained under conditions that are distracting in comparison with conditions that are free from distraction. A peculiar difficulty is encountered in the interpretation of these studies. It is a matter of common knowledge that when conditions are made more difficult an individual will usually rise to the occasion and overcome the difficulty. Experimental evidence supports this belief. One practically never exerts himself to the limit, either mentally or physically, so that there is a reserve of effort which may be drawn upon to over-

come obstacles (*313*). When motivation is built up, output of work will increase in nearly every instance and regardless of the kind of work. The use of such effort reserves is responsible for the effect of incentives to action (Chapter 22), whether it be memorizing a poem or acquiring an act of skill. Disturbances in one's environment *may* act as a stimulus or incentive to greater effort in order to overcome them, with the result that output of work does not decrease.

The tendency to adjust behavior to the size of the task is one of the most interesting of psychological phenomena. A very simple case of it occurs in the size-weight illusion, in which the relative weight of two objects is estimated. One of these objects is large and the other small, but they are of exactly the same weight and similar in appearance. When lifted one at a time in the hand, the large one seems light and the small one seems heavy. It is not uncommon to have persons report that the small one is four times as heavy as the large one. There is an involuntary adjustment of the effort to the *expected* weight, with the result that the small one is lifted with relative difficulty and the large one with relative ease. In learning, similar adjustments are found to occur where it sometimes happens that a large task is learned better than a small one, because the small one is taken too lightly or the large one is taken too seriously. These may be thought of as cases of over- and under-adjustment.

ADJUSTMENT TO PHYSICAL LOAD

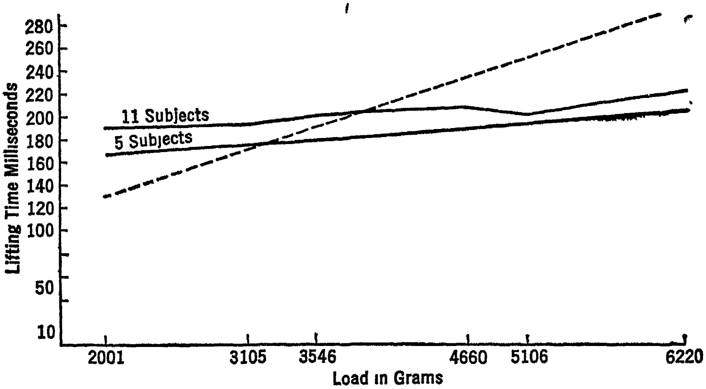
An adjustment of a somewhat different sort occurs in certain physical-work experiments. For instance, if a person is instructed to squeeze a hand dynamometer once with all his force, he will do a certain amount of physical work. If, however, he is required to make fifteen consecutive contractions with all his force, the first contraction will produce less work than when only one contraction is called for. The data * from seven subjects in an experiment of this sort show that when one contraction is required there is an average of 68 kilograms of pressure exerted, but when fifteen are called for there is an average of only 52 kilograms. Since the persons presumably "used all their force" in both cases, the difference is the result of an involuntary adjustment to the size of the task. The most striking evidence of such adjustments is to be found in the experiments of Morgan (*437*). The task consisted in exerting the "maximal effort" possible in lifting a weight which varied from 2,000 to about 6,000 grams (approximately 4 to 13 pounds). The time required for lifting should increase at a known rate as the weight increases if the effort exerted remains the

* A. T. Poffenberger (unpublished).

same. The dotted line in Figure 36 shows this increase in time that *should have occurred* with the different weights, whereas the solid lines show the changes in time that *actually occurred* with one group of 5 subjects and with another group of 11 subjects. The horizontal scale indicates the weights and the vertical scale shows the lifting time in thousandths of a second. It appears, then, that the lifting time tended to remain constant; therefore the effort exerted must have been adjusted to the size of the load, so as to keep the time fairly constant. An increase of 300 per cent in the load produced an increase in time of only about 16 per cent.

FIGURE 36

CHANGES IN RATE OF LIFTING WITH INCREASE OF LOAD*



* From J J B Morgan, "The Overcoming of Distraction and Other Resistances," *Arch. Psychol.* (New York), 1916, No 35, 70.

The tendency to adopt a certain rate of work regardless of the magnitude of the task is called by Morgan the "congenial pace." It varies for different people, but all show the adjustment to some degree. Some tend to set a pace that is too rapid for their strength, whereas others adjust themselves far below their powers. The adjustment process was especially clear where the weight was gradually decreased. In several cases the decrease in force exerted was so considerable that when the weight was changed unexpectedly from 2,000 to 6,000 grams the force being used was not sufficient to move the weight at all. An interesting type of adjustment is described as follows:

Subject Si, in his very first pull, made a score with the weight 6,220 grams of 100 sigma.* He threw himself into it with all his might. When it came up so quickly, he expressed his surprise that the weight was no heavier, and his next trial was 371 sigma. He was then told to do his best and pull all the time

* Sigma is the symbol for 1/1000th second, now more commonly designated a millisecond.

as hard as he did in the first trial, but either he could not or would not, for his times ranged from 206 to 261 sigma. This again goes to show that a subject expends energy in proportion to the idea he has of the difficulty of the task.

Subsequent research reported by Bills and Brown (*41*) has demonstrated that the "congenial pace" is not a simple and inevitable adjustment toward maintenance of a fixed time pattern as in Morgan's study, or toward a given effort as in the author's data (page 127). The set is rather a flexible adjustment which may owe its presence to a variety of conditions, such as the instructions of an experimenter, the presence of competition, a previous pace or schedule of work, or the mere knowledge that one is taking part in an experiment. The set may be in the direction of giving a maximal initial performance, of enduring over a long period, of maintaining uniformity of quality or quantity of output. One cannot predict just what the set will be in a given instance unless he is acquainted with the circumstances under which the work is being done. Thus Bills and Brown had subjects doing simple addition problems with a set for one or another of four lengths of work period, one, two, five, and ten minutes. Although the data do not have a high degree of reliability, they found the initial performance (first quarter minute) to increase with length of task, and the decrement during the first minute to increase with length of task.

MEASURING THE EFFECTS OF DISTRACTIONS

Such evidence as has just been presented makes it obvious that the effects of distractions cannot be safely measured in terms of output of work alone if one is really interested in the efficiency of the performance. Doing one's best, instead of being a fixed quantity, seems to be surprisingly variable. If a given level of output is maintained upon the introduction of some distracting influence there may or may not be a change in efficiency.

Where there is a falling off in output upon the introduction of "disturbances," the findings should be taken as evidence of a decreasing efficiency. Adjustments cannot entirely overcome the resistance in every case, so that a residue of effect will sometimes manifest itself. In the curves of Figure 36, there is not a 100-per-cent adjustment of effort to increase in weight, although if one estimated the load in terms of the time required to lift he would make a very serious error, indeed. Furthermore, the adjustment is not always immediate, and under some circumstances may develop rather slowly. This is clearly demonstrated in the adaptation to changes in industrial working conditions, where an adequate adjustment may require as much as five or six months (Chapter 23).

What should be the ultimate measure of the effect of distractions? The fundamental problem is one of cost in relation to output. A distracting noise that one apparently disregards by an added effort so as to keep up a normal flow of work may still be detrimental, if it is using additional energy. A useful measure of distraction would, then, be one directly in terms of energy consumed. It is possible, however, to approach the problem in a somewhat less laborious fashion. If overcoming distractions means using additional energy, how is this energy used? The extra work must consist either in the activity of mechanisms tending to inhibit the response to distraction, or in the increased activity of other mechanisms. The latter manner of consuming energy may be detected by looking for accessory muscular movements in the presence of the distraction.

MEASURING ADJUSTMENT IN TERMS OF ACCESSORY MOVEMENTS

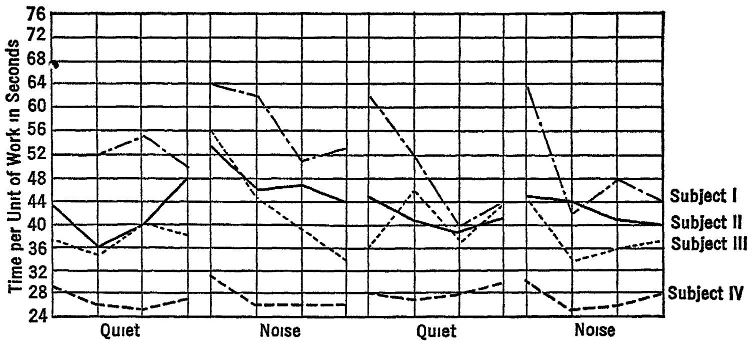
Morgan (*437*) found just such evidences of extra effort. He studied the effects of noises upon work requiring a high degree of attention and little susceptible to improvement from practice, and carried his tests over a fairly long period of time. Moreover, he attempted to measure the economy of the work as well as mere output. His findings are applicable, therefore, to experience with disturbances in everyday life. The work performed by his subjects consisted of a kind of translation of letters into numbers or numbers into letters by way of a code that varied in complexity in different sections of the experiment. Output was measured in terms of the time required for translating a given number of units of work, and the accuracy of the translations. Effort was measured in terms of the character of the breathing, the rate of breathing, and the amount of pressure exerted upon the keys which were struck in recording the translations. Additional measures were attempted but were found too difficult to control under the circumstances. The noises came from a great variety of electric bells and buzzers, the largest being an eight-inch fire gong. A series of six phonograph records was also used at times.

Figure 37 gives a graphic picture of the effects of the noises, and from it a number of important facts may be noted. The vertical scale indicates seconds of time required for a unit of work whereas the horizontal sections indicate the alternately quiet and noisy periods. In the quiet periods is shown the speed of the last forty reactions, in sets of ten, immediately before the noise is introduced, and in the noise periods is shown the speed of the first forty reactions immediately after the noise is introduced. The records of only four subjects are given

as samples. In the case of every person, the introduction of the noise slows the translating time. Recovery from this is rapid, however, so that the speed soon equals that of the quiet period. In three of the four cases shown, the speed at the end of the noise period is greater than at the end of the preceding quiet period. When the second quiet period begins, that is, after the noise has ceased, the speed of two of the subjects is decreased, showing that the shift from noise to quiet is disturbing for a few moments for some persons. When noise is introduced

FIGURE 37

THE EFFECT OF NOISE UPON OUTPUT*



* Compiled from J J B Morgan, "The Overcoming of Distractions and Other Resistances," *Arch. Psychol* (New York), 1916, No. 35.

the second time, the disturbance is again evident and the recovery rapid. Three of the four cases again show a faster speed at the end of the noise period than at the end of the preceding quiet period. The records of errors show no inferior grade of work during the noise and are too few to have any significance.

Concerning the results from eight persons subjected to this experiment, four of whom are charted in Figure 37, the author says:

At first thought it may seem to follow that a noisy condition is more favorable than a quiet one. If six out of the eight make a better time during noise than before the noises were introduced, and if six out of eight make slower time after the noises stop, might it not follow that noises have a dynamogenic effect, spurring the subject to increased activity? This might be a legitimate conclusion were it not for the initial retardation at the beginning of the noise periods. If the influence were one of simple dynamogenesis, it does not seem plausible that the first effect should be one of interference. If a motor is going at a certain speed and more current is turned on, it does not first stop or slow down and then take on speed and exceed its former motion, unless the direction of the increased current is reversed.

It is not, therefore, a legitimate interpretation of the data to ignore the slowing effect or pass over it lightly and say that in general the effect of noise is a

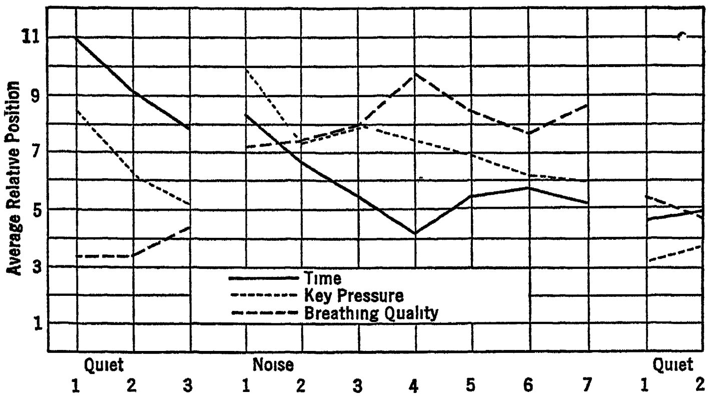
stimulation; just as it would not be a proper treatment of the data to average the whole period together and conclude that the noise had no effect.

After giving each feature of the results due weight we do not conclude that a noisy condition is just as conducive to good work as a quiet one. Our work thus far has simply served to show that noises have *some* effect upon work, and that the effect is a complex one.

The production curves should now be checked against the curves suggesting excess energy expenditure in order to see whether the adjustment to the noisy conditions involves additional cost. For this purpose the production records of all subjects are averaged and these,

FIGURE 38

EFFECTS OF NOISE MEASURED IN TERMS OF EFFORT *



* Compiled from J. J B Morgan, "The Overcoming of Distraction and Other Resistances," *Arch. Psychol* (New York), 1916, No. 35.

with all the energy measures, breathing quality and rate, and key pressure are reduced to a common standard. The data thus combined for all but the breathing rate are shown in Figure 38. The vertical scale represents the common standard for all measures,* and ranges from zero to twelve. Along the base line are shown in succession three quiet periods, seven noise periods, and two quiet periods. The noise periods represent the combination of bells and buzzers and the six phonograph records in the order in which they were presented.

The output record (in terms of time per unit of work) shows a disturbance at the beginning of the noise period with a gradual adaptation and improvement in speed during the series of disturbances. The key pressure records, on the other hand, show that greater effort was ex-

* The average relative position of any one noisy or quiet condition among the twelve conditions of the experiment. The noisy conditions were: (1) mixed noises; (2) phonograph record of concertina solo; (3) phonograph record of ocarino solo; (4) phonograph record of humorous dialogue; (5) phonograph record of humorous monologue; (6) phonograph record of tenor solo; (7) phonograph record of bass solo.

erted throughout the noise period than in either the second or third quiet period, with the greatest effort at the beginning of the noise period. The tension measured in this way is greater with the harsh noises than with the phonograph records. The breathing curve gives evidence only of the degree to which the breathing is disturbed through articulation, and shows, therefore, the extent to which this aid to attention had to be used to resist the noise distractions. The rising curve shows that most of the persons did not discover the value of this aid at once, but hit upon it gradually. The curve reaches its maximum in the middle of the noise period. When the quiet period follows the noise period, the key pressure is reduced and the breathing shows absence of articulation.

MEASURING ADJUSTMENT IN TERMS OF ENERGY EXPENDITURE

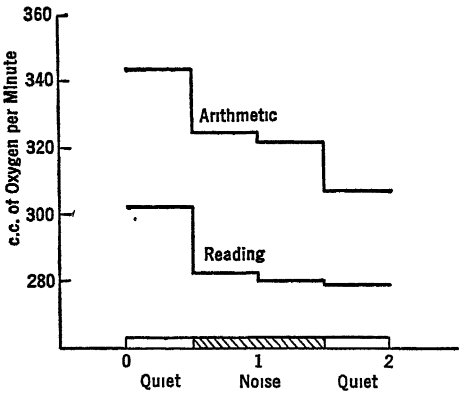
The indirect evidence which Morgan found for excess energy expenditure under noise distraction suggests the need for more direct evidence in terms of metabolic cost. Several studies of the sort have been reported. Laird (*354*) measured the energy cost of typing under noise conditions simulating those of the usual busy office by the technique illustrated in Figure 31. Part of the time the hard plaster walls of the laboratory were covered with a sound deadening material presumably absorbing about 50 per cent of the reverberation, and part of the time they were left bare. In the former case the metabolic rate was 52 per cent above the resting level, and in the latter it was 71 per cent above the resting level. The difference of 19 per cent was attributed to the reduction in noise level through the sound absorbing walls. So far as output of work was concerned there was an increase in speed per letter written of 4.3 per cent when the noise level was reduced. Without inquiring into the significance of a saving in energy of 19 per cent, the results, in conjunction with the change in output, do show a tendency to meet the adverse working conditions with an increase in energy expended.

Vernon and Warner (*665*) in seeking to develop a test for distraction measured both output of work and oxygen consumption in the course of reading and arithmetical computation under noise and quiet conditions. Their results on output confirmed those of Morgan that every type of noise or music, from a phonograph, metronome, bells, or a combination of sources, reduced somewhat the time required for a given amount of work. Metabolism measured in terms of cubic centimeters of oxygen absorbed per minute showed an increased absorption over resting of about 1 per cent for reading with noise and about 5

per cent for arithmetical work with noise. The combined records of two subjects taking part in this experiment are shown in Figure 39. It appears from these curves that whereas metabolic cost of the noise is greater than the final quiet period, it is actually less than the first quiet period. Vernon and Warner accepted the former as the better base from which to calculate the cost of noise. However, they concluded that the excess cost is so slight in any case that its estimation is useless as a routine test. Since the investigators were convinced that noises ought to be distracting, they finally resorted to subjective estimates on a five-point scale. Even with this measure, loud continuous noises did not seem to disturb, the only change of consequence coming from intermittent noises introduced into a process calling for concentrated attention.

FIGURE 39

METABOLIC COST OF WORK WITH NOISE *



* Adapted from H M Vernon and C G Warner, "Objective and Subjective Tests for Noise," *Person. J*, 1932-3, *11*, 144

Harmon (*241*) also studied the metabolic cost of doing mental work such as adding columns of figures in a quiet room, in a room where the noise from a large number of typewriters was reproduced by way of phonograph records, and where the noises of a busy city were similarly reproduced. When the noises were first introduced there was a temporary reduction in output of work and in accuracy accompanied by an increased metabolic rate per unit of work done. This is what one would expect from the work of Morgan and of Laird. It has been further confirmed by Poffenberger and Rounds * using the same setting as Harmon but with the introduction of certain additional controls.

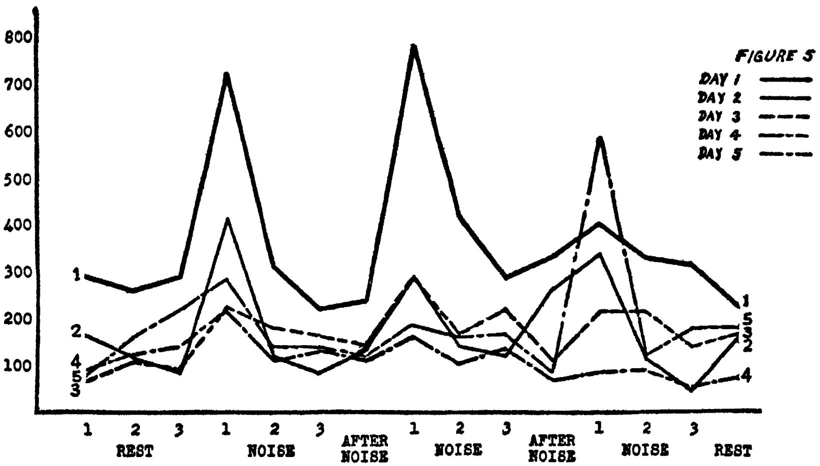
Upon the expectation that the increased metabolism during work under distracting circumstances would result from increased muscle tensions, Davis (*128*) undertook to look directly for evidence of such tensions in the presence of noise. His findings are illustrated in Figure 40. His eighteen subjects did no specific mental task, but sat either in quiet or noisy surroundings. First there was a five-minute quiet period followed by two minutes of noise, then two minutes of quiet, two minutes of noise, two minutes of quiet, and two minutes of noise. Muscle action potentials of the forearm served as the indicators of

* A. T. Poffenberger and G H. Rounds (unpublished).

tension. The curves of the figure represent such action potentials taken at the end of the third, fourth, and fifth minute of quiet, at the onset of each noise, and at the end of the first and second minute of each noise. Thus reading along the base line, one sees the three samples during quiet, then a sample at the beginning of the noise, and the two other samples at the end of the first and second minute. This is followed

FIGURE 40

THE EFFECTS OF DISTRACTION UPON MUSCLE TENSION[6]



6 From R C Davis, "The Muscular Tension Reflex and Two of Its Modifying Conditions," *Ind. Univ Pub, Science Ser*, 1935, No 3, 13

by one sample during quiet. This cycle is repeated twice. The experiment was run on five successive days and these are shown on the chart. Only the curve for the first day should be noted at this moment. It shows a sharp increase in action potential level at the onset of the noise in each instance. Here then is direct evidence of an effect of noise in a response of the peripheral muscles, along with which one might well expect an increase in the metabolic rate. These expectations are confirmed by Freeman (*182*) who measured output, metabolic rate, and muscle tension, and who found a decrease in accurate solution of problems, increased metabolic rate, and increase in muscle tension under noise stimulation.

IS INCREASE IN EFFORT ESSENTIAL IN ADJUSTMENT TO DISTRACTIONS?

The experiments of Harmon and of Poffenberger and Rounds were continued over many days and the most striking finding of both investi-

gators came from a comparison of results from day to day and from week to week. It was found that both the reduction in output and the increase in energy cost were only temporary and that in a surprisingly short time the worker returned to a normal output and normal cost per unit of work. The curves of Davis for successive days given in Figure 40 show a similar adaptation. Although it is difficult to follow with the eye all the points on the separate curves, each day has high points during noise which are lower than those for the preceding day. There is a striking difference in level between the first and the fifth day. Still more striking perhaps is the change within a given day. The greatest effect of the noise is immediate. On the first day the peaks of the third cycle are much lower than those of the first or the second cycle.

One is thus faced with the question as to how distractions are "met" or adjusted to and whether the adjustment is always costly to the organism. To put the matter in still another way, do distractions really create inefficiency?

Introspective reports taken during the distraction studies may throw light upon the problem. Distractions have generally been defined in objective terms. A noise is produced while one is working at arithmetic problems, lights are flashed while one is listening to words to be memorized, high atmospheric temperatures are introduced while one is judging the quality of compositions. Are they distractions? Strictly speaking they are distractions or distractors only if they distract. Many of the introspective reports show that when the objective conditions for distraction are present, the subject is not distracted. He may say that he "paid no attention," he "was not bothered," or he did not "notice the supposed disturbers." In such cases no increased effort seemed to be necessary and the output, as would be expected, was normal.

To account for the fact that distractors sometimes do not decrease output of work, and may even increase it, by saying that distractions do not distract is merely raising another question that demands an answer. Why do environmental conditions that are called distracting not distract? How can the organism "not be bothered" or just not pay attention? One suggestive bit of evidence to meet these questions comes from the research of Davis, just described, in which action potentials decreased during a five-day distraction experiment. Whether such changes in muscle tension as he recorded are causes or consequences of the adaptation cannot be stated definitely at this time. But if the former can be shown to be the case, then it would be a good guess that the peripheral sensory mechanisms together with the voluntary musculature taking part in the sensory adjustment process performed a protective function against distractors. By a reduction in tension (relaxation) they would transmit the otherwise disturbing stimuli at a

reduced level of intensity, a level too low for effective competition with more favored events.

If the tentative explanation just given seems to be weak or faulty, another is available that is almost exactly opposite in its implications. It may be introduced by the observation that not all conditions of distraction are resolved by ignoring them, or by not being bothered. The effort clearly demonstrated by Morgan is the response more commonly noted, particularly at the onset of the disturbance. Thereby the subject seems somehow to keep his performance to a prescribed level, or, in attempting to do so, exceeds it.

UTILITY OF EFFORT

What is the utility of the added effort in maintaining a level of achievement or in raising that level? Is such effort merely the subjective experience of wasted energy? The answer is not immediately obvious from a casual examination of the accessory mechanisms that are thus brought into action. It is the old physiological and psychological problem of dynamogenesis, but some light is being thrown upon it by current researches. The work of Freeman (*185*), who measured the specific tension patterns in groups of muscles by means of mechanical levers, and that of Jacobson (*310*) and Davis (*129*), who measured muscle tensions in terms of action currents, establish without question the existence of the tensions during effort. The work of Bills (*40*) and of Block (*49*), who deliberately induced muscle tensions in the course of mental work and measured their effects upon performance, gives quantitative evidence of the reinforcement that may thus be produced. And the work of Hartmann (*245*) (*246*) and others (*206*) (*537*) in their demonstration of the increase of subjective intensity of certain sensory experiences as a result of the simultaneous stimulation of other sense organs gives a hint of the possible mechanism of reinforcement in the presence of sensory distractors. If the stimulation of *other* sensory mechanisms raises the subjective intensity level of those experiences mediated by the sense having dominance at the moment, the latter should thereby become the more effective. In certain favored circumstances, therefore, the expected consequence of so-called distractors should be an increase in the efficiency of behavior. Are these favored circumstances to be found in the states of muscular tension such as those whose effectiveness has been demonstrated by Bills?

Two types of explanation for the meeting of distractions have now been offered: one was derived from introspective reports of certain subjects who were not distracted and from the study of the process of adaptation to distractions showing a reduction of muscle tensions with

time; and the other derived particularly from the study of that period immediately following the onset of a distraction and showing a reinforcement by way of the activation of accessory mechanisms. These two views, seemingly antagonistic, may be tentatively reconciled in either one of two ways.

The whole complex process of reacting to competing stimuli may be conceived as a process of sensory conditioning. Cason (*95*), after determining the subjective intensity of certain visual and auditory stimuli when presented separately, gave his subjects what he called a conditioned response training. This consisted in "evoking simultaneous visual and auditory responses a large number of times." Before the training, a stimulus affecting either one of two senses had the effect of increasing the subjective intensity of the other, thus supporting the findings of Hartmann mentioned above. "But after the conditioned response training, a stimulus affecting one of the two senses had the effect of decreasing the intensity of the other simultaneous sensory response." Thus, our two supposedly conflicting interpretations would seem merely to cover the two stages of an adjustment process, the first a reinforcing and the second a weakening one. There would remain to be explained just why in the first case the "appropriate" stimulus would be reinforced and why in the second case the distracting stimulus would be weakened. However, one need only appeal to the concept of "dominance" as elaborated by Razran (*512*) to account for such selective action in the phenomena of conditioning.

Or one may accept the increased tensions noted by Morgan as authentic and interpret the reduced tensions demonstrated by Davis as a *shift of tensions* to new muscle patterns with a reduction of tension only in those muscles on which measurements were at the time being made. The decreasing metabolic cost as adaptation to the distraction progresses would indicate merely that the later tension patterns were less extensive or less complicated patterns or functioned more economically than the earlier ones. The tension patterns would shift but would never disappear. There is evidence for such shifts of pattern in the experiments of Freeman (*185*) and of Jacobson (*310*). And the data of Jacobson give some support for the view that a tension pattern is always present during mental activity, since such activity is reduced to a minimum during a state of muscular relaxation.

The research of Bagchi (*22*) upon the adaptations of brain patterns to continuous and repeated sensory stimulation may have some bearing upon a possible interpretation of our findings if only to prevent the drawing of too hasty conclusions. He found, in the first place, that only 46 per cent of the first presentations of sound produced any change in the brain wave pattern, and in the second place there is an adap-

tation process as a consequence of which the pattern quickly returns to normal in the presence of the continuing or intermittent stimulus. After disposing of the view that the adjustment of brain waves is to be attributed to the adaptation process within the neural elements involved, Bagchi concludes:

> All these considerations would lead one to conclude that the arrival of nerve impulses from the peripheral mechanism at the brain is not the only important factor in reducing the brain waves. The cause of the variation lies in how and when the peripheral impulses strike the brain. It appears that the particular location or state of the whole cortex, or rather a complex pattern of the organism with its physiological and psychological components, determines whether or how much of the influence of the incoming stimuli is going to be admitted, modified, or thwarted.

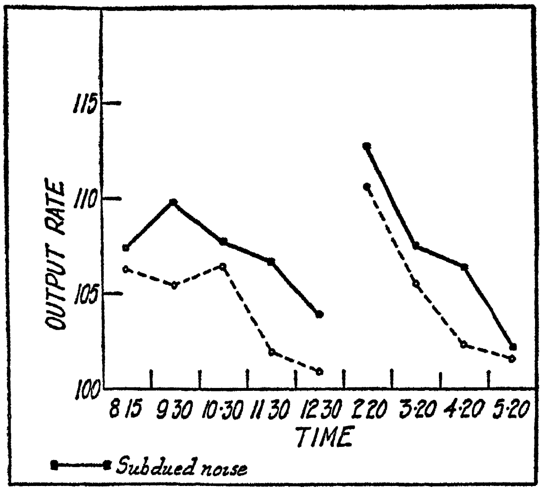
THE EFFECTS OF NOISE UPON EFFICIENCY

This long and perhaps tedious discussion has been necessary in order to prepare an adequate answer to such a very simple question as "What is the effect of noise upon efficiency of work?" For a casual search of the literature brings one first to the research of Morgan which shows that noise effects cannot safely be measured in terms of change in output. The phenomena of adjustment come at once to the foreground and lead to the search for a real measure of distraction. The inevitable conclusion seems to be that no stimulus in itself can be called a distractor. Whether or not it will distract depends upon the characteristics of the organism that receives it (*295*). And even if it is at one moment a distractor, the extent to which it shall continue as such depends upon the stimulus-organism relationship. Not only are there the usual differences that are to be expected from individual to individual, but within the individual there are variations from stimulus to stimulus and from moment to moment in reaction to the same external situation. These statements are borne out by data from the survey of Weston and Adams (*697*) who charted the output of a group of ten weavers, over a period of twenty-six weeks. On thirteen alternate weeks the weavers wore ear plugs that reduced the noise level from 96 decibels to 87 decibels, and on the remaining weeks hearing was unimpeded. The authors report an average improvement in personal efficiency of 12 per cent from the reduction in noise level. Individuals, however, gave widely varying records. Moreover, the effect upon output could not be inferred invariably from the introspective reports of the sensitivity or immunity to the noise. Figure 41 gives the contrasting average daily records of two workers whose introspective reports did accord with their output. The solid line in each case gives the subdued noise output and the broken line the noise output. Worker B said noise disturbed her,

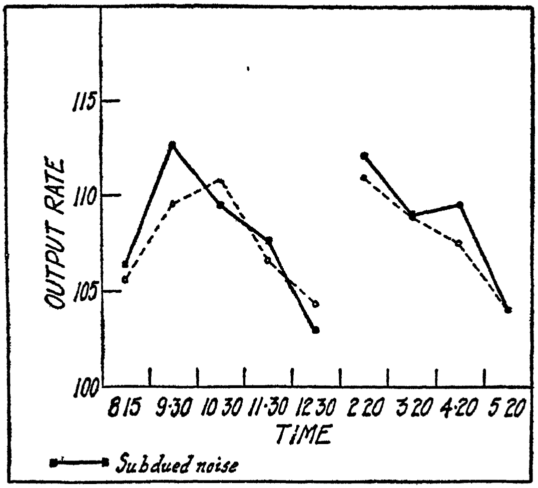
FIGURE 41

THE EFFECTS OF NOISE UPON INDUSTRIAL OUTPUT*

Worker B



Worker L



* From H. C Weston and S Adams, "The Effects of Noise on the Performance of Weavers," *Industr. Hlth Res. Bd*, 1932, No 65, pp 49 and 50.

whereas worker L said it did not. For the former the quieter period gave consistently better performance, while for the latter there was no consistent difference between the two noise levels.

In spite of the uncertainties of prediction just indicated, a few facts are worth noting:

1. It should be remembered that the experiments that have been quoted do not cover long periods of continuous noise such as one finds in numerous industrial plants and business offices. What the wear and tear under such circumstances would be must be left largely to speculation.

2. In general those stimuli are most disturbing that affect the sense organs that are directly involved in the work, rather than relatively inactive organs (*164*). Thus if one's work involves constant conversation or constant use of the telephone, a high level of noise would be equivalent to a certain degree of deafness. It would lower the efficiency of hearing.

3. The disturbing effect of noise tends to be directly related to its suddenness or unexpectedness (*37*). One must say that this only tends to be the case, however, because there are occasions when the expected sounds, as those occurring at a regular rhythm, are the more disturbing.

4. In general it would seem that stimuli that are meaningful carry the greatest distracting power because one is drawn to attend not merely through the intensity but through the quality of the experience (*353*) (*437*). However, there seem to be exceptions to this statement, notably in those cases where students can do intense mental work in the vicinity of a blaring radio. Instances have even been reported in which they complained of inability to study when their radios were out of order.

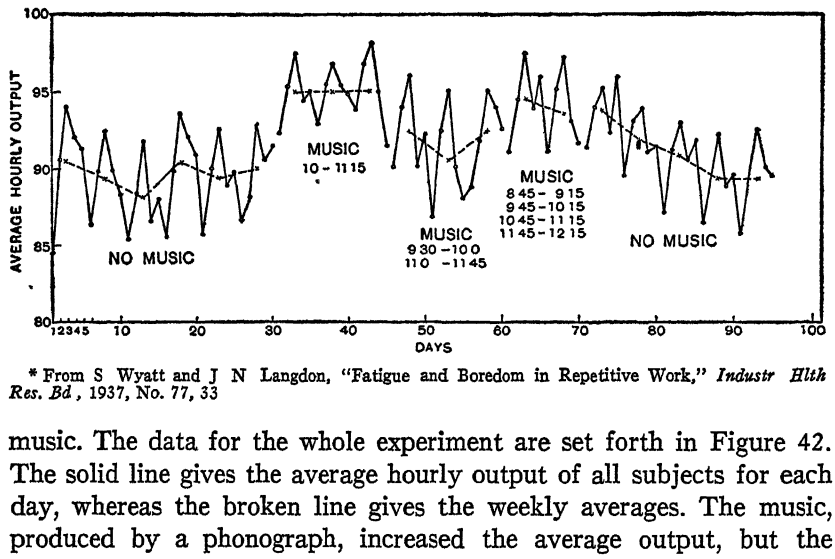
THE EFFECTS OF MUSIC UPON PERFORMANCE

Such meaningful stimuli as have been used in the study of distraction are more properly called sounds than noises for they may comprise music and the spoken word as in conversation. The literature upon the effect of music usually emphasizes its facilitating influence, for music has been used to incite to action since the time of the early Greeks. Instances will readily come to mind such as the use of the marching music of military bands and the rhythmic songs of laborers (*137*). The whole question of the reinforcing power of music has recently come to the fore with the increasing ease of the reproduction and amplification of sound. One frequently reads reports of the use of music delivered over a public address system for increasing the output and satisfaction of dock workers, industrial laborers, and of office employees. The expectation of beneficial results rests mainly upon the belief that boredom is owing to the consciousness of uniformity and repetition, so that whatever will "take the mind off" will reduce the boredom. It should be noted, among other things, that the activities most commonly reported to be reinforced by music are the motor

processes of industrial operations in which auditory components are lacking or are at a minimum. Wyatt and Langdon (*726*) tested the effect of music upon such an operation. It was the making of paper "snappers," the completion of each one requiring about thirty seconds. The output of twelve young workers was recorded at fifteen-minute intervals during the day. Five morning conditions were tested over a period of ninety-five days as follows: Thirty days without music; then fifteen days with seventy-five minutes of music in one single session; then fifteen days with thirty minutes of music followed after a half hour by forty-five minutes of music; then ten days with four thirty-minute periods at half-hour intervals; and finally twenty-five days without

FIGURE 42

THE EFFECTS OF MUSIC UPON PERFORMANCE *



* From S Wyatt and J N Langdon, "Fatigue and Boredom in Repetitive Work," *Industr Hlth Res. Bd*, 1937, No. 77, 33

music. The data for the whole experiment are set forth in Figure 42. The solid line gives the average hourly output of all subjects for each day, whereas the broken line gives the weekly averages. The music, produced by a phonograph, increased the average output, but the amount varied. The largest increase, 6 per cent, resulted from morning music; the smallest, 2.6 per cent, from one period each in morning and afternoon; and an intermediate change of 4.4 per cent from four periods in the course of the day. Although the averages show consistent improvement from the music, individuals differed in their reaction to it. The majority of the workers benefited, but there were several who were either not affected at all or were affected adversely. These results are consistent with the findings of others concerning distractions.

Humes (*301a*) studied the effects of phonograph music upon the output of eighty-eight female assemblers of radio tubes over a period of many weeks. His interest was focused upon the scrappage rate and its correlation with the presentation of slow music, fast music, mixed pro-

grams of slow and fast music, and no music at all. It should be noted that the experiment was conducted in a plant where it had been customary for years to furnish music regularly during the day. Both slow and fast music showed less scrappage than the absence of music or than mixed programs. Other results were less clear-cut, the mixed programs, for instance, making for improvement only when certain tube models were being assembled. Employee morale was reported to be higher with music than without it. The author exercises commendable caution in interpreting his results, pointing out reversals of effect, the specificity of the effect, and also the possibility that non-musical factors might have influenced his results.

OTHER DISTRACTING INFLUENCES

In addition to noises, two other sources of distraction have been rather extensively dealt with in business and industry, namely, visual distractions arising from defects in the system of illumination and from the presence of polished surfaces of desks and machines, which reflect light; and ventilation distractions arising from the discomfort of hot, cold, and humid atmospheric conditions. In so far as the effects of poor lighting are not limited to eyestrain and its consequences from conditions unsuitable for the needed acuity of vision, they are probably the effects of the distracting power of poorly distributed lights. And in so far as ventilation conditions do not produce a direct organic effect showing itself in loss of appetite and weakened physical condition, they also are reducible to the distracting influence of bodily discomfort. These matters will be discussed in the following chapters and their influence demonstrated in laboratory and field studies.

There is one other source of distraction which is not found in the external environment. It lies rather in the realm of memory, imagination, and day dreams of the individual For whenever the mind at work tends to be drawn off into "wool gathering" excursions it is suffering distractions just as real as if it is attracted to a loud sound. Such distractions will be examined in a later chapter on Monotony. (Chapter 10.)

It seems scarcely worth while to attempt to catalogue other distractions, in the light of our analysis of distraction at the beginning of this chapter. They are so much a product of the interaction of the individual and his working conditions, rather than a characteristic of the objective situation, that a distraction in one set of circumstances turns out not to be a distraction in another set of circumstances.

The practical rule would seem to be that, owing to the uncertainties of predicting results, where work of high quality or in large quantity

is to be done the environment should be as free as possible from distra tions of all sorts. In certain industries where efficiency methods ha been introduced, not only such simple distractions as lights and sound uncomfortable and ill-suited clothing have been eliminated, but mo complex mental distractions such as fear of accident have been remove by safety appliances, fear of sickness by introduction of methods sanitation, fear of leaving dependents unprovided for by the introdu tion of insurance schemes. If the reports are to be accepted, efficien is increased by these means. The rule will apply not only to high organized industries, but the individual may find means of eliminati from his own environment many apparently slight distractions whi in the course of weeks or months might conceivably make a conside able drain upon his energy.

8

The Influence of Environmental Conditions: Illumination

The illumination under which people live and work is one of the most insistent of the many factors affecting their efficiency and comfort. Its significance is growing every year, with the increase in industrial operations calling for speed and fine visual control, with the increase in volume of reading matter and its accessibility to all people, and with the phenomenal proportions of the motion-picture audience in the United States. Along with the increasing demand upon the eyes, there has gone a chain of improvements in artificial lighting that have tended to encourage the use of the eyes under more and more hours of artificial illumination. This last fact constitutes a problem in itself since daylight illumination without special efforts for its control is the more likely to be satisfactory. The distressing disclosures concerning the state of the vision of the population, estimated from the Selective Service sample, calls renewed attention to the need for discovering the causes of visual defect. Whether the causes are found to reside in excessive use of the eyes, or merely excessive use under poor conditions for seeing, it is necessary to seek optimal conditions of illumination wherever artificial lighting is necessary.

PSYCHOLOGICAL PROBLEMS OF ILLUMINATION

Illumination poses a variety of research problems, some of which have been answered through careful experimentation and some of which are still unanswered. All of these problems have psychological angles to them and many of them have been investigated by psychologists (*175a*). The acknowledged importance of human satisfaction in adequate adjustment (Chapter 24) directs attention to the feelings of discomfort and the sense of effort from work under poor illumination. Then there are the general physical and mental effects that are attributed to eye-strain. Finally, there is the discovery of the psycho-

logical factors that must be allowed for in measuring visual reaction under experimental conditions, and which have been discussed in Chapter 7.

CHARACTERISTICS OF THE VISUAL MECHANISM

Effectual lighting methods are conditioned by certain characteristics of the visual mechanism, characteristics that are innate and consequently common to all human beings. A description of these characteristics will clear the way for a discussion of illumination problems. First among these conditions is the natural tendency to turn the eyes toward bright objects in the field of vision so that the light shall cast an image upon the center of vision, which is the region for clearest seeing upon the retina. This turning of the eyes is synonymous with visual attention; it appears soon after birth and is one of the first signs of the infant's attention to its surroundings and its discrimination of objects. Not only does it appear early, but it is never completely outgrown. The actual movements may be inhibited, not, however, by a failure of the muscles to contract, but as a result of the voluntary contraction of antagonistic muscles. Any attempt, then, to prevent this visual act of attention, if it succeeds at all, requires extra muscular effort voluntarily controlled and consumes energy. The turning of the eyes should be understood to include both convergence and divergence in shifting the gaze from far to near and vice versa, as well as turning both eyes from side to side.

The second important characteristic of the visual mechanism, and one that is closely related to the first, is the nature of the sensitivity of the retina to light. The main point to be noted is that the retina differs considerably in sensitivity in its different parts. It is commonly supposed that, because one can see most distinctly when looking directly at any object, the part of the retina thus concerned, the so-called center of vision, is also the most sensitive. This, however, is not the case, for the region around the central one is much more sensitive to variations when the level of light intensity is low. The difference may be described by saying that the peripheral parts of the retina are adjusted for dim or weak lights, whereas the center of the retina is adjusted for bright lights. So true is this that the center of vision with which one sees best in bright lights is practically blind in dim light, and the peripheral parts are used for vision in its stead. This rather striking fact may escape our observation, yet a very simple experiment will at least give an indication of it. If one watches for the stars to appear as darkness descends in the evening, he is surprised to discover them first out of "the tail of his eye"—that is, he sees them first in indirect

vision, or with the sensitive peripheral region of his retina. What are the consequences of this adjustment of the peripheral retina for very weak lights? Every one knows the unpleasant effects experienced upon coming from darkness into very bright light, a temporary blindness, or if not that, an uncomfortable glare which rather quickly disappears. Even more exaggerated glare effects are produced when localized bright lights fall upon these sensitive peripheral regions of the retina.

A third characteristic of the eye is the tendency of the accommodation mechanism always to adjust itself so as to see clearly or focus properly upon the object which is being looked at or attended to. So, just as there is a tendency to turn the eyes toward a bright object in the visual field, so is there a tendency to focus upon it in order to see it clearly. This is either a native reaction or it is acquired extremely early in life, and is almost impossible to overcome, as any one knows who has tried to learn to fixate a given near object while attempting to pay attention to another more distant object. There is thus a constant conflict between the tendency to accommodate for the object of involuntary attention and the object voluntarily looked at.

A fourth characteristic very closely associated with the third is a tendency to adjust the size of the pupil of the eye according to the distance of the fixation point. The greater the divergence of the eyes in order to look at a distant object the larger the pupil becomes, and the nearer the object fixated the smaller the pupil becomes. In fact, convergence, divergence, accommodation, and expansion-contraction of the pupil are all so intimately united in function that when any one of the three responses occurs the other two will occur in sympathy with it.

A fifth characteristic is the contrast effect produced when neighboring parts of the retina are stimulated with lights of different intensities or colors. For instance, when a dark and a light object are viewed side by side, the white looks whiter and the black looks blacker than if seen alone. In a word, the contrast effect is always in the direction of the greatest opposites, a light object inducing a dark by contrast. This phenomenon is especially pronounced upon the peripheral parts of the retina, hence a bright object seen in an otherwise dark field has its brightness enhanced and an uncomfortable glare is produced.

Whatever makes for blurred vision will set this interlocking mechanism into activity. One of these conditions is improper illumination which results in low visual acuity. Another condition, of which the general run of people are more aware, is the blurred image on the motion-picture screen resulting either from improper focusing of the projector or from one's sitting too near the screen. The useless striving for clear vision is, according to Ferree and Rand (*172*), the cause

of eye strain, which frequently "leads rapidly to fatigue and exhaustion, to deformities slight in their physical magnitude but great in their functional importance, to inflammation and congestions, and to hypertensions and other conditions not found in a healthy eye."

This very simple statement concerning visual function should provide the minimum of information upon which to examine the facts of illumination. These facts will first be concerned with the amount and kind of illumination necessary for clear and effective vision under various circumstances; and, second, with the probable distracting power of variations within the visual field created by uneven distribution of the illumination.

INDIVIDUAL DIFFERENCES IN SENSITIVITY TO LIGHT

Every estimate of the amount of illumination needed for satisfactory vision must be prefaced with the statement concerning individual differences in visual response. For the differences among people in this respect should be expected to be as great as in any other realm of behavior. Ferree and Rand (*172*) have emphasized this much neglected aspect of vision by stating the respects in which individuality should be sought, by devising instruments and techniques for measuring them, and by providing some data. They consider the following variables especially pertinent for determining the optimal vision for any person:

> (*a*) His preferred intensity of light; (*b*) his range of toleration for intensity for comfortable use of his eyes for the work he is most accustomed to do and for different types of work; (*c*) his susceptibility to glare; and (*d*) his need for color correction.

As an illustration of the magnitude of the individual differences to be expected in these respects, the data provided by Ferree and Rand for the upper limits of light intensity for comfortable reading are given in Table 16. They are derived from the measurement of 550 normal

TABLE 16

RANGE OF THE UPPER LIMITS OF INTENSITY FOR COMFORTABLE VISION *

Foot-Candles of Light	*Percentage of Subjects*
0—5	1.7
5—10	11.3
10—15	26.5
15—20	20.8
20—30	17.7
30—40	8.0
Above 40	14.0

* From C E Ferree and G. Rand, "Good Working Conditions for Eyes," *Person. J.*, 1936-37, *15*, 339.

persons ranging in age from 10 to 77 years, who read a page printed in ordinary 8-point type. Examination of this table shows that less than 10 foot-candles of light is adequate for 13 per cent of the group, whereas 14 per cent require more than 40 foot-candles. Ferree and Rand place the normal range between 10 and 30 or 40 foot-candles. Values below or above this range would be considered signs of hypo- or hyper-sensitivity. There may be some hazard in accepting such an extent of individual differences as covering all the variables mentioned by Ferree and Rand, but it will have to suffice until other data become available.

THE DETERMINATION OF ILLUMINATION NEEDS

All published statements of the illumination needs for various kinds of visual work should be interpreted in the light of expected individual differences. In fact the discrepancies in the published estimates are certainly due in part to this variable. Another troublesome source of difference is to be found in the method of determining the proper intensity level. To mention only a few of these, there is a method which calls for a momentary response under a given condition either for determining the minimal threshold or the acuity threshold. Contrasted with this is the method advocated by Ferree and Rand of measuring the response that can be maintained for as much as three minutes. Results obtained by these two techniques should be expected to differ, although one cannot say necessarily which should give the higher or lower threshold. Again, results will certainly differ according to whether the given intensities are intended to satisfy minimal requirements or optimal requirements. Published statements do not always make clear just what is the criterion of adequacy. Finally, closely related to the point just mentioned is the great flexibility of adjustment of the eye to changes in stimulus intensity so that if tests are not carefully controlled the optimal point might be located anywhere within a very wide range. When one passes from sunlight into an artificially lighted room, the latter will appear quite dark, but it will very soon "brighten up." One will not realize, however, that the change has been from an intensity of about 10,000 foot-candles to about five foot-candles. In a few minutes the room light will be adequate for efficient vision.

There are, then, three sets of factors that bear upon the question of the adequate light intensity. The first is the matter of differences among individuals which makes it impossible to provide the optimal conditions for every individual in a group. The best that can be done, where adjustments cannot be made for each case, is to strike a level that will be *adequate* for all. The second factor somewhat offsetting the

first is the rapid and extensive adaptation to light intensity changes by which every normal person can, after a few minutes of adjustment, see effectively over a great range of intensities. The third fact is the striving for clear vision, with such consequent eye-strain as to make imperative the proper provision for clear seeing by means of sufficient light intensity.

PRACTICAL LIGHTING REQUIREMENTS

Minimal and desirable degrees of illumination have been specified for business and industry in New York State and these have been set down in a code (*307*) from which the following items have been selected. The first column of figures stands for minimal foot-candles of light at the working surface, and the second column stands for desirable levels:

	Minimum	*Desirable*
1. Work not requiring discrimination of detail such as handling material of a coarse nature and performing operations not requiring close visual application	0 50	1 00— 2 00
2. Washing machines, hydro-extractors, starching	0.50	1 00— 2.00
3. Rough work requiring discrimination of detail, also work in basements of mercantile establishments requiring discrimination of detail	1 00	2 00— 4 00
4. Mixing and baking operations	1.00	3 00— 4.00
5. Rough work and work in basements of mercantile establishments requiring closer discrimination of detail	2 00	4 00— 6 00
6. Switchboards and transformers	2.00	4 00— 6.00
7. Fine lathe work, pattern and tool making, and office work such as accounting and typewriting	3 00	6.00— 8 00
8. Glass etching	3 00	6 00— 8.00
9. Fine work such as watch-making, engraving, and drafting	5 00	8 00—15 00
10. Sewing, stitching, inspecting, and finishing gloves	5.00	8 00—15 00

The following intensities are recommended as minima of general illumination in the revised American Standard Code of Lighting School Buildings (*8*). The figures are again in terms of foot-candles at the working surface:

1. Locker room, corridors, stairs, passageways, and all indoor areas traversed by students	4 00
2. Gymnasium, for all types of activity	15.00
3. Shops and laboratories	15.00
4. On desks and blackboards in classrooms; on desks and tables in study halls, lecture rooms, and libraries	15 00
5. On desks in offices	15.00
6. Sewing rooms, drafting rooms, art rooms, and other rooms where fine detail work is to be done	25.00

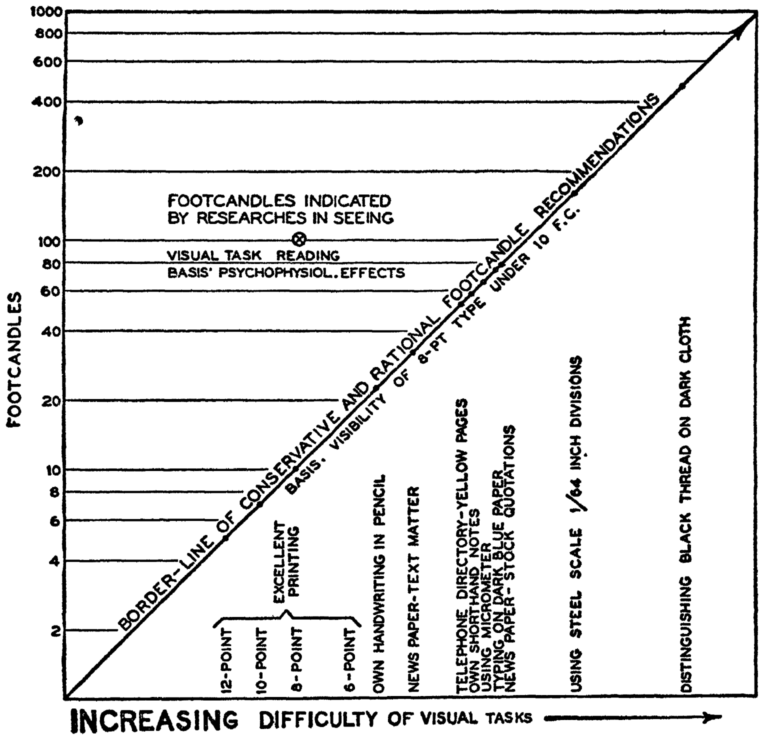
It will be noted that the minima of this series are about five times as high as the minima of the Industrial Code, and one and a half to three times as high as the "desirable level" of the Industrial Code. Tinker

(*645*) (*646*) criticizes these estimates as too high and places the critical level for the well-adapted eye at about 3 foot-candles. When the intensities are lower than this, clearness of seeing is reduced during two hours of reading.

Still higher minimal and desirable intensity levels are advocated by Luckiesh and Moss (*388*) who put "the ideal intensity for reading

FIGURE 43

MINIMAL ILLUMINATION FOR VARIOUS CONDITIONS *



* From M Luckiesh and F. K. Moss, *The Science of Seeing* (New York, D. Van Nostrand Co., 1937), p 344.

large type excellently printed" at about 100 foot-candles. Taking as the standard of adequate visibility, 10 foot-candles of light on 8-point type of excellent printing, black ink and dull white paper, they derive the equivalent minimal amounts of light necessary for a variety of conditions. These are shown in Figure 43 reproduced from Luckiesh and Moss. The vertical scale shows foot-candles of light from 0 to 1,000 and the base line shows the various seeing conditions. It appears from this chart that reading of the usual newspaper requires about 40

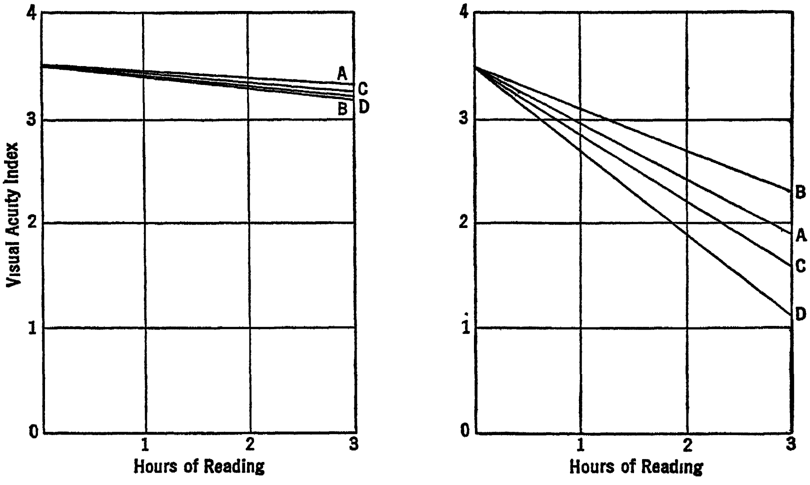
foot-candles, whereas reading a telephone directory requires nearer 60 foot-candles.

Ferree and Rand (*174*) have shown by their three-hour reading test technique that where the distribution is uniform (indirect lighting), there is practically no difference in the effects of intensities ranging from 1.33 to 5.2 foot-candles at the reading surface. In the absence of uniform distribution (direct lighting), however, not only are all intensities more fatiguing, but an intermediate intensity is better than either a higher or a lower one. The highest intensity was the most fatiguing. These factors are demonstrated in Figure 44.

FIGURE 44

RELATION BETWEEN RATE OF FATIGUE AND INTENSITY OF LIGHT *

Lighting System: Indirect						*Lighting System: Direct (8 Lamps)*					
	Watts	Volts	Foot Candles				Watts	Volts	Foot Candles		
			Vertical	Horizontal	45°				Vertical	Horizontal	45°
A ...	200	107	1.33	0.39	0 87	A ...	120	107	0.64	0.32	0.49
B ...	320	107	1.70	0.49	1 08	B ...	200	107	1.16	0.45	0.85
C ...	480	107	3.00	0.76	1.97	C ...	320	107	1.97	0.65	1.39
D ...	800	107	5 20	1.36	3.50	D ..	480	107	2.60	1.02	2.00



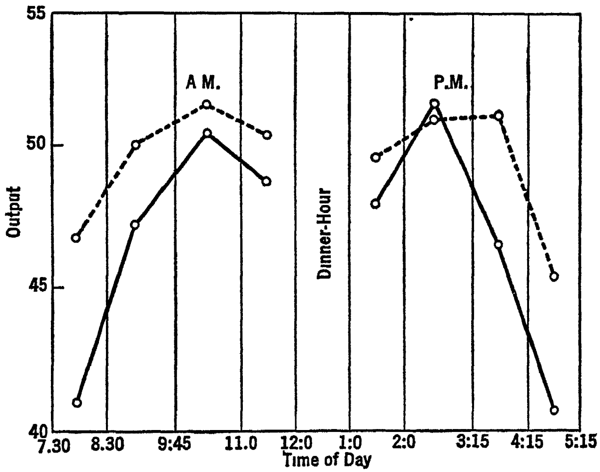
* From C E. Ferree and G. Rand, "Lighting in Its Relation to the Eye," *Proc. Amer Phil. Soc.*, 1918, *57*, 456.

Figure 45 will serve as an illustration of the many field studies of illumination in industry made by the Industrial Fatigue Research Board of England (*162*). It gives a graphic illustration of the effects of

poor artificial illumination as compared with ordinary daylight illumination. The only known difference in the conditions determining the output represented by the dotted and the solid lines is the fact that the latter include days on which artificial illumination had to be used during the first hour of the day and the last hour of the day, whereas on the days represented by the dotted line no artificial illumination had to be used. Each curve represents the output per hour as indicated along the base line. Not only is the output lower in the first hour of the morning when artificial illumination was used, but it remains considerably lower during every hour of the day except one.

FIGURE 45

The Influence of Poor Illumination upon Output *



* From P M Elton, "A Study of the Distribution of Output in Silk Weaving During the Winter Months," *Industr Fat Res. Bd. Rep.*, 1920, No 9.

It would seem that any ill effects that were suffered during this first hour were serious enough to disturb the performance of the workers during the rest of the day. This is, doubtless, an extreme case since the work studied was silk weaving and the type of illumination was such as to leave exposed to the eye unshaded incandescent bulbs hanging at about the level of the eyes. Such conditions violate all the laws of good illumination.

This discussion of the light-intensity requirements for efficient work may be appropriately concluded by a brief reference to the frequently quoted illumination experiments of the Western Electric Company (*528*, 14-18) which covered a period of two and one-half years and which eventually employed all the experimental controls that a psychologically acceptable technique would require. At the end of three ex-

periments, the mass of confusing data led to the suspicion that the results secured were "more psychological than real." A final check experiment verifying this suspicion is described thus:

> The experimenter was not yet completely satisfied that it had been clearly demonstrated that the effects of illumination secured in the previous studies were "more psychological than real." He therefore decided to try further tests on the girls in the coil windings group. First, the amount of light was increased regularly day by day and the girls were asked each day how they liked the change. As the light was increased, the girls told the investigator how they liked the brighter lights. Then for a day or two the investigator allowed the girls to see the electrician come and change the light bulbs. In reality, the electrician merely took out bulbs of a given size and inserted bulbs of the same size, without in any way changing the amount of light. The girls, thinking that the light was still being "stepped up" day by day, commented favorably about the increase of light. After a few days of this, the experimenter started to decrease the intensity of light, keeping the girls informed of the change and soliciting their reaction. After a period of this day-by-day decrease in illumination, he again allowed the girls to see the electrician change the bulbs without really changing the intensity of the illumination Again the girls gave answers that were to be expected, in that they said the "lesser" light was not so pleasant to work under as the brighter light. Their production did not materially change at any stage of the experiment. (*528,* 17)

QUALITY OF ILLUMINATION

The whole question of the value of colored illumination has taken on increasing importance with the invention of the gas-filled light bulbs and the fluorescent light source. In the latter one has at once an almost unlimited range of colors to choose from, available at higher intensities than were previously feasible for colored lights, effective at much lower temperatures and at a current cost far below that of the ordinary light sources. The versatility of the new light sources was amply demonstrated at the New York World's Fair. What the effect will be upon the human organism working under their influence will not be known without extensive research.

Concerning the value of different color qualities of the illumination, little is definitely known. The restful effects attributed to the carbon lamps and the oil lamps of earlier days are doubtless due to their relatively low intensity, with its advantages wherever direct lighting is used. The question of color therapy, or the use of colored lights for the treatment of diseases, mental and physical, has attracted attention at various times. A large body of tradition has accumulated concerning the efficacy of certain colors, especially in the treatment of nervous affections. Space will not permit a discussion of the curative powers which colors are supposed to have; moreover, no scientific data con-

cerning them are available. The use of colored spectacles, such as amber, rose, and smoked glass, is mainly to reduce the intensity of the light, although special properties have at various times been attributed to certain colors. Here, too, experimental data are meager.

The choice of light quality depends largely upon the purposes that the illumination is intended to fulfil. The main goal may be efficient seeing as in an industrial plant requiring a high level of visual discrimination; it may be lower illumination cost for a given required efficiency; it may be the maximum of comfort in vision as in the lounge of a club; it may be the optimal aesthetic effect as in certain rooms of the home; it may be a matter of health where the ultra-violet or the infra-red rays should predominate; or the case may be a very special one as in the accurate matching of colors at home or in industry. Not all of these special needs can be explored here. Convenient sources of information together with technical data may be found in the literature of vision (*388*).

QUALITY OF LIGHT AND VISUAL EFFICIENCY

Momentary visual acuity seems to be greatest for light that has approximately the composition of daylight. With colored lights the red end of the spectrum was found by Rice (*515*) to be more favorable to acuity than the green, the values for the red being from 20 to 50 per cent above those for the green. The values for blue are similar to those for green but somewhat lower. The experiment of Fernberger, Viteles, and Carlson (*169*) is particularly pertinent in this connection because it shows the elaborate technique that is required to control all the variables in the practical measurement of acuity. It shows, further, the need for reservation in carrying the findings of the laboratory, where the needed controls can be maintained, to the practical working situation. They attempted to determine the best quality of light for inspecting white flannel for slight defects (removing dark hairs and foreign matter). To do this they took the problem into the laboratory where they employed the psychophysical method of constant stimuli and where the materials were exposed in a tachistoscope under standardized conditions of light, adaptation, timing, and practice.

Three qualities of light were investigated, derived from the standard Mazda lamp, the C2 Mazda "daylight lamp" (bluish), and the mercury-vapor lamp. The highest acuity was obtained with the C2 Mazda, the next with the Standard Mazda, and the poorest with the mercury-vapor lamp. An additional discovery of interest in connection with the previous discussion of intensity was that an intensity of eight foot-candles (C2 Mazda) gave a better acuity than one of

18 foot-candles. The study emphasizes once again the importance of experimental controls and of the psychological factors in seeing. The authors rightly caution against too ready acceptance of their data for application in the field because of the brief duration of their tests.

The fatigue test of Ferree and Rand (*174*) shows much the same results as the two studies just cited. By using various light sources that were available at that time, they were able to get a series of colored lights ranging from orange-yellow to blue-green. Their results in terms of the percentage of loss of efficiency in acuity after three hours of reading time and the time required for feelings of discomfort to appear are shown in Table 17.

TABLE 17

FATIGUING EFFECTS OF LIGHTS OF DIFFERENT COLORS *

Colors	*Percentage Loss of Efficiency*	*No. Seconds after which Feelings of Discomfort Appeared*
Unsaturated yellow	5 43	116
Reddish yellow—more saturated	7.57	94
Unsaturated yellow, with trace of red	8.29	90
Orange-yellow	8 39	90
Unsaturated yellow, with trace of green	8 48	90
Unsaturated yellow, with more green	24 00	48
Unsaturated yellowish-green	25 51	34
Unsaturated yellowish-green, with more green	33 14	25
Greenish	39.14	25
Bluish-green	54.86	14

* From C. E Ferree and G Rand, "Some Experiments on the Eye with Different Illuminants," Part II, *Trans. Illum Eng Soc*, 1919, *14*, 116.

DISTRACTING EFFECTS OF LIGHT

It was found in the preceding chapter that sounds, whether noises or tones, were potential distractors of attention whenever they intruded into the field of experience and were not at the moment the legitimate objects of attention. Variations in illumination, from whatever cause, are likewise potential distractors. They are, moreover, peculiarly insistent distractors. Their potency as disturbers may not be obvious to casual observation for one can surely close his eyes or turn his head and thus escape their influence, whereas in the case of hearing there is no such ready and convenient control. However, if one is engaged in visual work and at some specific location he may be able neither to turn his head nor to close his eyes. Assuming that such protective devices as

these cannot be used, then the five characteristics of the visual mechanism described above tend to exaggerate the variations, that is, to make more uneven the distribution of light. Thus it happens that evenness of distribution of light, though its importance for actual seeing may not be so great as at one time supposed, is highly important for comfort and effectiveness of work that involves the visual process.

DISTRIBUTION OF LIGHT

From these considerations we can derive one of the most fundamental and yet one of the most often violated laws of illumination, namely *that the whole visual field should be as nearly uniformly lighted as possible.* If a person is reading in a room with a ceiling light and unscreened side lights along the walls, each one of the latter forms a bright image or a glare spot upon the sensitive peripheral part of the retina. Contrast effect with the darker background tends to make this image appear even brighter than it is. This stimulation of the retina arouses the reflex tendency to turn the eyes toward the light source, and at the same time the tendency to change the accommodation of the eye from a near point to a far point. One of three effects will be produced: the reflex responses will occur, with the consequent distraction of the attention from the book; they will be inhibited as a result of the contraction of antagonistic muscles, at the expense of considerable strain and effort; or there will be a continual fluctuation in direction of the eyes and in their accommodation from the book to the distracting light. Muscular strain thus generated will produce pain in the eyes and head, nervousness and general fatigue, in addition to the discomfort resulting directly from the glare.

It is largely the value of uniformity of illumination which makes natural lighting, or daylight, more efficient than artificial lighting, because with the former an even distribution of light is more likely to be attained without intention. Even here, however, there may be a lack of uniform distribution. Wrong location of the windows and skylights, incorrect color of wall coverings and window shades, and the presence of polished surfaces from which the light may be reflected may serve to weaken the advantages of natural light. Most of these faults may be corrected by simple means such as using ground glass in windows, removing polished objects or giving them a dull finish, and painting the walls a soft yellow or gray. If the walls are very dark, as with blackboards in schoolrooms, there is so much difference in the intensity of the direct light from the windows and the reflected light from the walls, that the uniformity of distribution of light is destroyed, and the evil glare effects of contrasting surfaces appear. The polished nickel trim-

mings of a typewriter or its glossy white keys are sufficient to add much to the strain and fatigue of a few hours' work.

UNIFORMITY OF ARTIFICIAL ILLUMINATION

It is with artificial lighting that the most flagrant disregard of this rule of even distribution occurs. In lighting from exposed sources it is not unusual to find the brightest surface from 1,000,000 to 2,500,000 times as brilliant as the darkest; and from 300,000 to 600,000 times as brilliant as the reading-page. These extremes of brightness in the field of vision are, tests show, very damaging to the eye.

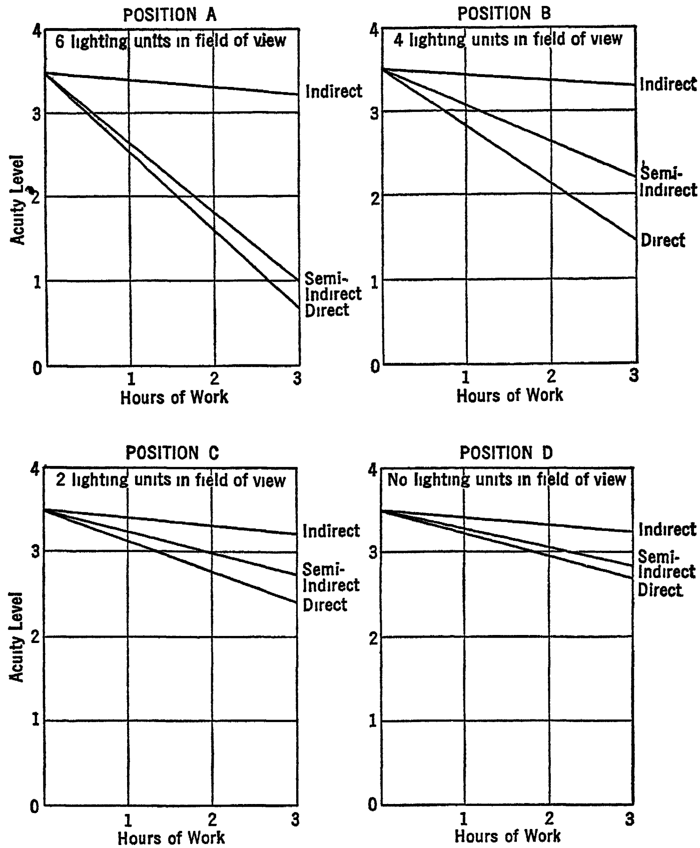
It is naturally difficult to get uniformity of illumination where the sources of light are necessarily so near as they are in ordinary rooms. Many innovations in lighting systems have been employed to offset this defect. Although there are hundreds of light sources, shades, and reflectors on the market, there are only three classes of illumination as far as evenness of distribution is concerned. They are the direct lighting, in which the rays of light reach the working surface without reflection; indirect lighting, in which all the rays are reflected from ceiling, walls, or other surfaces before reaching the working surface; and the semi-indirect, in which part of the light is received direct and part reflected. The commonest lighting is of the first sort, where the light source is bare or has a simple shade above it. Such an arrangement will expose the eye to the direct rays of the light source and give the maximal irregularity of distribution and the maximum of discomfort. In the indirect system the light source is completely hidden, either in an inverted opaque bowl, or behind a molding of some sort. In the semi-indirect system the source is enclosed in a translucent inverted bowl so that a portion of the light comes directly through the bowl and the remainder is reflected from the ceiling. This system varies considerably in efficiency according to the translucency of the bowl. When it is very translucent it is little better than the direct system; when it is very opaque it differs little from the indirect system. The indirect system would seem to be the most efficient so far as distribution is concerned in spite of the fact that a greater light intensity at the source is required to allow for loss through reflection, with a consequent increase in cost.

The laboratory studies of these three kinds of light distribution and of many other aspects of illumination that have been made by Ferree and Rand (*174*) enable one to state their relative value in terms of the working efficiency of the eye. They measured the effects of three hours of steady reading in terms of discomfort and the onset of fatigue. For the first they accepted the introspective report of trained subjects. For

the second they determined the ability to sustain clear seeing during a period of three minutes. The measurements were made at the beginning of the period and at the end of each hour thereafter. This fatigue test devised by Ferree is much better than the simple acuity test, because

FIGURE 46

Changes in Visual Efficiency During Three Hours' Work *



* From C E. Ferree and G. Rand, "Lighting in Its Relation to the Eye," *Proc Amer. Phil. Soc.*, 1918, *57*, 440.

even when the eye is greatly fatigued it has the power to attain a high degree of acuity for just a moment. Clear seeing, however, cannot be maintained for any length of time when the eyes are fatigued. Figure 46 shows the changes in efficiency during three hours of reading for the three kinds of light distribution, when there is a varying number of lights within the field of vision, depending upon the position of the reader. The hours of work are given along the base line, and the degree

of power to maintain clear seeing is indicated on the scale at the left. The rate of fatigue is indicated by the fall of the curve Thus, all the curves show that there is relatively little change during the three hours' work when indirect lighting is used. The fatigue is greatest in every case for the direct lighting. Between these two lies the semi-indirect. The smaller the number of lights within the visual field the more closely do the direct and the semi-indirect systems approach the indirect. This means that the presence of the bright spots produced by the light sources is the most potent factor in fatigue. In other respects the three systems do not differ much.

IMPROVING UNEVEN LIGHT DISTRIBUTION

Although evenly distributed illumination such as is produced by daylight and by indirect artificial light properly installed gives the best results, it is worth while to consider how the system of direct lighting may be made less offensive. This will be especially valuable if it gives to the individual a means of protecting himself against lighting conditions over which he has little control. Three possibilities present themselves. The first is to lower the intensity of the light at its source, thereby reducing somewhat the unevenness of the general illumination. It is evident that this remedy can be applied only within limits, and that, as long as there is enough light for distinct vision, the bare light source will have all the disadvantages previously mentioned. The second method is to shade the eyes from the direct effect of the light. This is commonly done and does decrease the discomfort somewhat. It has been found from tests that if eye shades are to be used they should preferably be opaque rather than translucent, and lined with white next to the face rather than with dark material. Unfortunately, most of the eye shades that are on the market are provided with a dark undersurface. Reference to the four characteristics of vision as described at the beginning of the chapter will show that the dark lining of an eye shade will decrease the evenness of illumination and produce glare by contrast between the dark surface of the shade and the light of the lamp. Moreover, the edge of the shade, being dark against the light, will tend to attract the attention away from the real source of interest, and at the same time tend to produce visual accommodation for this extremely near point, with eye fatigue as a result. The translucent eye shades are usually green and are good only as they approximate the opaque, but they still have the disadvantage of being dark.

The third possible correction for the defects of direct lighting consists in putting shades directly upon the light. This is generally prefer-

FIGURE 47

Illumination Creating Glare Spots *

FIGURE 48

Illumination Free from Glare Spots *

* Courtesy of The Waverly Press, Baltimore, Maryland

able to the use of eye shades and is good to the extent that it hides the source of the bright light and approximates the effect produced by indirect lighting and daylight. It will always be, however, only a makeshift and less efficient than the indirect lighting system.

A thoroughly effective attack upon the problem by the proper diffusion of daylight and the correct installation of the best lighting fixtures is illustrated in Figures 47 and 48. In addition to the improvements that can be noted by casual comparison of these two photographs, there is an automatic control of the artificial light so that a uniform level of illumination is maintained at all times. When daylight illumination is for any reason decreased, enough artificial light is added to make up for the deficit. The system of controlled mixing of natural and artificial light is becoming a fairly common practice, particularly in public schools (*170*).

An entirely new means of meeting the problem of distribution may come with the use of the fluorescent lamp. There is claimed for it a softness, absence of shadows, and uniformity of distribution not attained by other means than daylight. These results are undoubtedly due largely to the great surface area of the light source and to the character of the fixtures in which it is installed, although something may be contributed by the light itself. Whatever the cause, even distribution seems to be more readily obtained than by the more customary illuminants.

THE EFFECT OF MOTION PICTURES UPON VISUAL EFFICIENCY

The widespread popularity of motion pictures as means both of entertainment and of education raises the question as to their effects upon vision. If we examine the motion-picture experience in relation to the important facts of vision described in the beginning of this chapter, we find that the distribution of light is uneven, the great brilliance of the screen against the intense dark background gives strong contrasts, and incorrect adjustment of the projector gives blurred images. All of these conditions lead to eye fatigue. Furthermore, since the visual contrast phenomena are more pronounced in the peripheral parts of the visual field than in the center, the fatiguing effect should be greater if the spectator sits near enough to the screen to project the margin of the picture—where the contrast between light and dark is greatest—into this sensitive region. The flicker and unsteadiness of the picture, which were so prominent in the earlier pictures and have not been entirely eliminated from the best of the modern ones, are believed by most people to be the primary cause of eye discomfort.

Ferree and Rand (*171*, 491), who investigated the motion picture some twenty-five years ago, have analyzed the effect thus:

The eye is so constituted that when its images lose in clearness or distinctness it is incited to a muscular readjustment to bring about the clearness needed. Ordinarily in seeing, the conditions for loss in clearness come about primarily through the difference in the distance or direction from the eye of the objects which are successively viewed. In motion pictures, however, the changing clearness of the objects viewed is not due to any change in their distance or direction from the eye; nor to anything in fact which the readjustment of the eye can remedy to any considerable degree. The effort expended, therefore, is of little avail for seeing, if, indeed, the new setting of the parts is not a detriment to clear seeing and a condition which in turn must be corrected. This should, and doubtless does, lead to muscular strain and loss of efficiency.

The investigators just quoted measured the fatiguing effects of watching motion pictures for two hours, in a favorable environment and with the most improved type of motion-picture apparatus in use at that time. The decreased ability to sustain clear seeing after the motion-picture experience was the measure of fatigue. The results show a considerable loss of efficiency. When compared with the use of the eyes for other purposes, however, the loss does not seem excessive. For instance, it was found that the loss was for one person somewhat less than he experienced from three hours' reading from clear type printed on good paper under the direct or semi-direct system of lighting. It has been inferred from the data taken from two subjects that the loss is just about as great as would result from an equal time spent in reading under usual conditions of artificial illumination. The distance from the screen had some influence upon the degree of fatigue. At a distance of 25 feet the loss was about 50 per cent; at a distance of 48 feet it was about 30 per cent. Improvements in comfort and efficiency may be expected, therefore, from increases in steadiness of the picture, from providing a suitable minimal distance of the observer from the screen and by increasing the general illumination of the room so as to break down the extreme contrasts of dark and light and reduce the necessity for rapid shifts in retinal sensitivity.

ADJUSTMENT TO VISUAL DISTRACTIONS

One of the striking characteristics disclosed by the study of noises was the degree to which the subject rises to meet them, so to speak, keeping his objective performance constant by some kind of adjusting reaction. The question may well be raised whether the same sort of adjustment occurs to visual disturbances. From the insistent character of visual stimuli it might seem that visual distractions should not be so readily met. Evidence on the question is scanty, but one incidental

finding of Johnson (*327*) seems to be pertinent. He measured the sensitivity of the eye to differences in light intensity by means of the reaction-time technique. He found that under certain circumstances the more difficult the task of observing the light stimulus, the better is the quality of the performance as measured in terms of reaction time. He explains this result by saying that "the more unfavorable the conditions of observation the greater the degree of 'volitional attentive effort.'" This experiment furnished one additional instance, then, of adjustment of attentive effort to maintain a given quality of reaction. That the adjustment "overshoots the mark," as it sometimes did in the experiments of Morgan, does not lessen the significance of the adjustment. There is, to be sure, no direct demonstration of increased energy expenditure in Johnson's subjects, but "increased volitional attentive effort" implies increased muscular tensions and these should have their counterpart in altered metabolic rate. Here within the field of vision, just as in the realm of sound, the individual tends to maintain a certain standard of achievement or exceeds that standard in the face of obstacles at the cost of increased effort if not of increased expenditure of energy.

9

The Effects of Atmospheric Conditions upon Achievement

No list of the conditions to which the human organism must adjust itself would be complete that did not give ample attention to atmospheric conditions. One may live in a climate that is predominantly hot or cold, dry or moist, in a high altitude with its rarified air or at sea level with its heavier air. He may be subjected to slight changes in these conditions from one season of the year to another or to great fluctuations. He may enjoy a high sunshine index or he may endure a low one. Within a given climate he will experience weather conditions ranging from warm to cool, from calm to windy, from clear to rain each with more or less duration. Approximately half of his life will be spent in daylight and half in darkness, the exact proportions of these depending upon the season of the year and upon the latitude. Moreover, at one time he will be indoors where there will be more or less distortion of the natural atmospheric conditions and at other times he will be in the open where nature alone will regulate the weather.

What is the effect of all these conditions of climate, altitude, season, weather, rhythm of day and night, indoors and out-of-doors? The answer is growing in importance year by year. Increasing speed and ease of travel make change of climate possible to greater numbers of people; airplane travel brings more and more people into high altitudes; air-conditioning of the home and working environment makes desirable conditions more attainable if we know what these are; and, finally, the discovery of the importance of sunshine for a healthy body economy raises interesting and important questions about the optimal sunshine requirements, the use of glass that will admit all the rays of the sun into the home, and the use of ultra-violet lamps and sun lamps when sunshine is not available. Surprisingly little is known about many of these questions, and research is urgently needed. Space will not permit a consideration of all of them, but attention will be given to those upon which most research has been done, and which are inherently most interesting to the student of psychology.

VENTILATION

The condition of the air in which one lives has been recognized as a factor in efficiency since the seventeenth century. The tragedy of the Black Hole of Calcutta, pictured in the following paragraph (*371*), has frequently served as an example of the effect of lack of ventilation.

> One of the hottest of the hot nights of British India, a little more than one hundred and fifty years ago, Siraj-Uddaula, a youthful merciless ruler of Bengal, caused to be confined within a small cell in Fort William one hundred and forty-six Englishmen whom he had that day captured in a siege of the city of Calcutta. The room was large enough to house comfortably but two persons. Its heavy door was bolted; its walls were pierced by two windows barred with iron, through which little air could enter. The night slowly passed away, and with the advent of the morning death had come to all but a score of the luckless company. A survivor has left an account of the horrible happenings within the dungeon, of terrible strugglings of a steaming mass of sentient human bodies for the insufficient air. Within a few minutes after entrance every man was bathed in a wet perspiration and was searching for ways to escape from the stifling heat. Clothing was soon stripped off. Breathing became difficult. There were vain onslaughts on the windows; there were vain efforts to force the door. Thirst grew intolerable, and there were ravings for the water which the guards passed in between the bars, not from feelings of mercy but only to witness in ghoulish glee the added struggles for impossible relief. Ungovernable confusion and turmoil and riot soon reigned. Men became delirious.... All efforts for relief were vain until at last bodily and mental agony was followed by stupor.

EARLY EXPLANATIONS OF THE EFFECTS OF POOR VENTILATION

One need only appeal to his own experience for proof that being confined in a crowded, poorly ventilated room produces drowsiness, lassitude, and even severe headache or fainting. To correct the evil, it is not enough to blame the bad air—one must know just why the air is bad, what makes it bad. Mere opinion and popular prejudice cannot be relied on to discover the cause, but the results of scientific experiments must be sought. One of the earliest explanations of the effects of bad air, before chemical analysis of the atmospheric air had been made, was that the human body exhausted the aerial spirit of the air, a substance necessary for the preservation of life. Another view was that the human body gave off noxious vapors which poisoned persons inhaling them. After the analysis of air into its chemical constituents, the aerial spirit needed to preserve life became oxygen and the noxious gases became carbon dioxide. The effects of bad air were then thought to be owing to the decrease of the oxygen and the increase of the carbon dioxide components of the air. This is the view that is prevalent in the popular mind today. Experimental work, however, does not

support this theory. Pure air contains, among other constituents in small proportions, the following:

	Per Cent
Oxygen	20.93
Nitrogen	79 04
Carbon dioxide	0 03

In the most poorly ventilated schools and factories the oxygen is reduced to only about 19 per cent and the carbon dioxide is increased to only about 0.3 per cent. But in order that any harmful physiological effects can be demonstrated, the oxygen must be reduced to 14 per cent and the carbon dioxide increased to 2.4 per cent. It is clear from such figures that the ill effects from poorly ventilated rooms cannot be attributed to reduction in oxygen nor to increase in carbon dioxide, nor even to a combination of both.

The theory of "crowd poison," as it was called, next developed and received much support even as late as 1911. According to this theory organic matter given off by the lungs and the body surface contained a poison, called anthropotoxin. The odor of foul air was supposed to be an index of the presence of this poison. Definite proof of this theory seemed to be obtained by condensing expired air and administering the solids and liquids so obtained to guinea pigs. Ill effects thus produced were attributed to the presence of the anthropotoxin. Later experiments showed that the technique of these tests was in error and that the conclusions were false.

PHYSICAL THEORY OF VENTILATION

If bad air is not bad on account of its chemical constituents, low oxygen content, high carbon dioxide content, or the presence of toxins, what is the cause of the indisputable ill effects of poor ventilation? Chemical theories have been replaced by physical theories, and the practical problem has become one of maintaining a proper body temperature.

The human body has an intricate set of mechanisms for holding a given optimal status within its various organs and within the organism as a whole. This condition has been named homeostatis by Cannon (*79*). The equilibrating mechanisms enable the human organism to maintain a steady normal temperature when exposed to a dry heat as high as 250 degrees Fahrenheit, and to low temperatures equally extreme. When these stabilizing controls fail to function properly the body temperature may rise above the normal whereupon the subject has a fever, or it may fall below the normal temperature whereupon he has a "chill." Either condition is destructive to the bodily well-

being, the life of the individual cells depending on a maintenance of this norm. Fever is accompanied by abnormal chemical changes within the tissues and the production of toxic substances, which in turn react upon the tissues, diminishing their working power, inducing early fatigue, and upsetting the normal equilibrium of the organism generally.

The body is constantly producing more heat than is necessary for maintaining this normal temperature as a result of muscular, nervous, and glandular activity. The excess is given off partly by way of the expired air, partly by convection (air currents) and by radiation from the body surface into the air surrounding the body, and partly by evaporation of the perspiration thrown out upon the skin by the sweat glands. The three processes of convection, radiation, and evaporation depend not only upon the body and its condition, but also upon the physical characteristics of the air surrounding the body. If, for instance, the temperature of the air is higher than that of the body, direct radiation from the body to the air does not occur, but rather the opposite. Further, if the air is already saturated with moisture, evaporation cannot occur. In this state the two most important factors in maintaining a normal body temperature are absent, and the body suffers from overheating. Thus it may be said that the two conditions of the air which demand attention are temperature and humidity, and not chemical constitution.

Any careful observer will discover that the interrelation between temperature and humidity as factors in body heat regulation is not simple. He will discover that a high humidity along with a fairly high temperature increases the feeling of warmth, whereas a high humidity when the temperature is lower increases the feeling of cold. Compare the effects of moisture in air on a warm summer day and on a cool spring day. Humidity not only reduces the rate of evaporation of moisture from the body surface and exerts a warming influence, but it also increases the heat conductivity of the air and thereby exerts a cooling influence. Which effect will be dominant depends upon the prevailing temperature. Below 70° F. the heating effect of increased humidity is negligible whereas its cooling effect through increased radiation is great. Above 70° F., on the other hand, the cooling influence of increased radiation is very slight, and the inhibition of evaporation greatly increases the feeling of warmth. At about 68° to 70° F. there is a neutral zone, where humidity has little effect.

The experiments conducted by the New York State Ventilation Commission (*659*, 96) have demonstrated that, if a number of individuals are kept in an air-tight chamber with the air unchanged for a number of hours, they show the usual symptoms of poor ventilation.

If they are allowed to breathe fresh air by means of tubes leading from the outside of the room into their nostrils these symptoms do not disappear. And, if an individual on the outside of the room is required to breathe the much-used air from within the room by means of tubes, he does not show the symptoms. Hence the character of the air that is breathed is not the cause of the symptoms. The experiment room, used by the New York Ventilation Commission, was equipped with devices for changing the air in any fashion; for example, temperature, humidity or stagnancy, and the effects of each change upon a variety of body functions could be determined. It was found that any change which will remove the excess heat from the body will reduce the unpleasant symptoms. Stirring or disturbing the air with electric fans, thereby driving the hottest air away from the skin, will bring relief at once by increasing radiation, and drying the air will do likewise by increasing the rate of evaporation from the body surface.

THE INFLUENCE OF VENTILATION CONDITIONS UPON PHYSICAL WORK

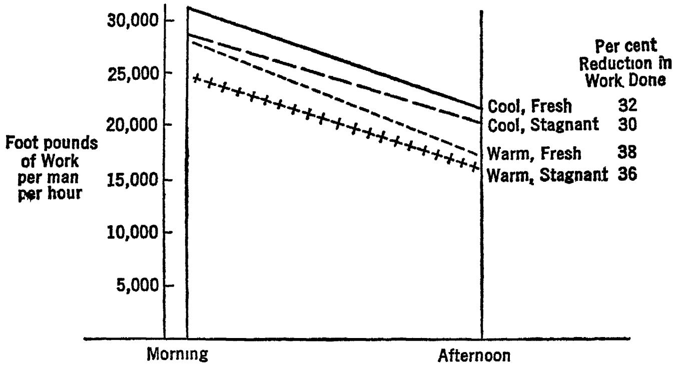
The effects of any given set of conditions upon performance can be measured in a great variety of ways. As a reference to Chapter 6 will remind the reader, one of the commonest, easiest, and most practically useful measures is in terms of output. A consideration of ventilation may well begin, therefore, with a question concerning its effect upon output of physical work. The ventilation study just referred to attacked this question and found that atmospheric conditions that interfered with elimination of excess heat reduced output. The work consisted in periodically lifting a five-pound dumb-bell through a distance of two and one-half feet, making 11.25 foot-pounds of work per lift. The report concluded as follows (*659*, 96):

> When men were urged to work they accomplished 28 per cent less total work in a day in an atmosphere of 86° F., 80 per cent relative humidity, than at 68° F., and 50 per cent relative humidity. When left to themselves, but stimulated by a bonus, they performed per man per hour in the four atmospheric conditions of 68° F. fresh air, 68° F. stagnant air, 75° F. fresh air, and 75° F. stagnant air, the decreasing series of 100, 91.1, 85.2, and 76.6 percentages of work. During the warmer hour, regardless of whether the fresh air was supplied or not, the subjects performed 15.4 per cent less work than during the cooler hour. With no fresh air supplied, regardless of the two temperatures employed, they performed 9.4 less per hour than when abundant fresh air was given them. In stagnant air at the lower temperature they performed 8.1 per cent, and at the higher temperature 10.1 per cent, less work, than when fresh air was supplied. While in the cooler air the afternoon hour, when fatigue was present, if compared with the forenoon hour, irrespective of air supply, showed a falling off of 31.8 per cent of work; in the warmer air, the fall was as much as 36.9 per cent.

Figure 49 shows these data graphically. The two points on the curves show average output in the morning and in the afternoon in terms of foot-pounds of work per man per hour. Four curves indicate the effects of the various combinations of temperature and air movement.

FIGURE 49

EFFECTS OF AIR CONDITION UPON PHYSICAL WORK *

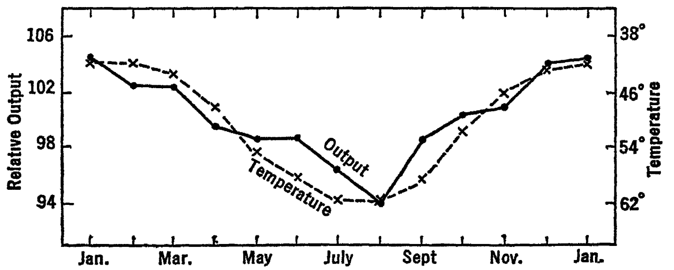


* From *Ventilation*, Report of the New York State Commission on Ventilation (New York, E P. Dutton and Co , 1923), p 95.

Field studies in industry suggest that the temperature and humidity of the worker's environment through their influence upon body temperature play an important part in determining output. Investigations of this sort leave many variables uncontrolled, when compared with a

FIGURE 50

RELATION BETWEEN OUTPUT AND SEASONAL VARIATION IN TEMPERATURE *



* From H. M Vernon, "The Influence of Hours of Work and of Ventilation on Output in Tinplate Manufacture," *Industr Fat Res Bd Rep.*, 1919, No 1

typical piece of laboratory research, but their findings take on added significance when they corroborate the latter. A good instance of such supporting field work will be found in Vernon's (*662*) investigation of mill-workers engaged in the manufacture of tinplate. Figure 50

shows the variation in output at different seasons of the year. The scale on the left indicates the relative output, that on the right shows the temperature, and the scale along the base line shows the months of the year during which output was measured. The solid line representing the output follows very closely the course of the dotted line which represents temperature. It should be noted that output in this type of work which is very heavy is greatest when the temperature is lowest. In light operations such as silk weaving the optimal temperature is relatively high.

When ventilating devices are employed, a large part of the seasonal variation indicated in the chart may be eliminated and the output kept near that of the optimal season. For example, in the tinplate mills output was measured under ventilated and unventilated working conditions. It was found that in two unventilated factories the average output was, respectively, 11 per cent and 18 per cent less in the hottest weeks of the year (when the mean temperature was 65° F. or more) than in the coldest weeks (when the temperature was 40° F. or less). In the ventilated factories it was only 8 per cent less. The conclusion is drawn that thoroughly efficient ventilation may be expected to increase the average output of a previously unventilated factory by 12 per cent or more. The primary effect of the type of ventilation used in this study was movement of the air which reduces the body temperature by increasing the rate of evaporation from its surface.

The English investigators attach great importance to ventilation as an efficiency factor, and in their field studies they make use of the Kata-thermometer (*238*) for making more delicate diagnostic measurements than can be obtained with the ordinary thermometer. This instrument measures the power of the atmosphere to cool the skin surface, a function which depends upon the temperature, the humidity, and the rate of movement of the air. The temperature and humidity of the work room, when air movement is disregarded, do not give a satisfactory measure of cooling power. The use of this instrument has shown that the atmospheric conditions vary considerably from one part of the work room to another, so that the conditions for a worker may be much more unsatisfactory than a casual ventilation survey of the room would indicate. In the neighborhood of machines, especially, the conditions are likely to be found unsatisfactory. Tentative norms for rate of cooling have been established for several occupations, for different seasons of the year, and for different types of buildings.

INFLUENCE OF VENTILATION CONDITIONS UPON MENTAL WORK

The results of the experiments of the New York State Ventilation Commission upon mental work (*659,* 97-126) are in strong contrast to their findings for physical work. A variety of mental operations ranging from the simple cancellation of numbers to complex judgments of specimens of composition were investigated under extremes of temperature and humidity. It was found that when an individual is urged to do his best, he does as much and does it as well, and improves as rapidly, when the air is hot, humid, stale, and stagnant (86° F. and 80 per cent humidity, with no fresh air movement) as under optimal ventilation conditions (68° F., 50 per cent humidity, and plenty of circulating fresh air). Table 18 gives the results for twenty subjects,

TABLE 18

THE EFFECT OF ATMOSPHERIC CONDITIONS UPON PERFORMANCE *

Temperature	68° F.	68° F.	86° F.	86° F.	86° F.
Humidity	50	50	80	80	80
Air Supply	Fresh	Recirculated	Recirculated	Fresh	Recirculated
Fans	None	None	High speed	None	None
TESTS					
Color naming (time)	1 00	.99	.98	.99	.99
Opposites (time)	1.00	1.00	1.03	1 09	1 05
Cancellation (time)	1.00	1 02	.99	.99	1 00
Addition	1.00	1 03	1 01	1.00	1 02
Mental multiplication	1.00	1.07	1 09	1.05	1.01
Typewriting	1.00	.96	1 01	...	.98

* Adapted from *Ventilation,* Report of the New York State Ventilation Commission (New York E. P. Dutton and Co., 1923), pp. 99-100.

working four hours per day under each of five atmospheric conditions for five days. The condition was changed daily so that in the five days of any given week all conditions were present. On one day of each of the five weeks the same condition obtained. The tests employed will be sufficiently identified by their names. The data are expressed in terms of ratios of the bad condition to the good condition, which was 68° F., relative humidity 50 per cent, with fresh air. Where score is in time the better records will give the lower percentage. None of the differences is large enough to be significant.

In an experiment upon fifteen persons, subjected to two extreme atmospheric conditions for four hours daily and for five consecutive days, the results are essentially the same. The results are given in Table 19 where the data are in terms of the ratios of the bad condition to the good one. None of these differences is large enough to be significant.

TABLE 19

EFFECT OF CONTINUOUS SUBJECTION TO ATMOSPHERIC CONDITIONS UPON PERFORMANCE *

Temperature *Humidity*	68° F. 50	86° F. 80
Cancellations 2's	1.00	.94
Cancellations 3's	1.00	1 00
Addition	1 00	1.06
Mental multiplication	1.00	1.02
Typewriting	1.00	1.01

* Adapted from *Ventilation*, Report of the New York State Ventilation Commission (New York, E. P. Dutton and Co., 1923), p. 102.

There arose in the minds of the experimenters the possibility that the subjects were somehow rising to meet the difficulties created by the bad conditions, that they strove to maintain a given pace, with the result that any ill effects might not be evident in records of output and errors. To check on this possibility a series of situations was introduced in which the task was of no interest to the worker, in which he had no way of judging the quality of his work, and in which there was no obvious incentive to fast and steady work. It consisted of judging the quality of compositions according to an arbitrary scale of values, with no opportunity to check for correctness of judgment. There was, according to the report, no evidence of inferiority of performance under the worst conditions as contrasted with the best. There were instances of slower work and more frequent rests under the worst conditions but there was no uniformity in such responses.

In one series of experiments in which the temperature alone was varied from 68° F. to 75° F. and in which the individual was left to his own choice as to whether to do mental work, read stories, rest, sleep, or talk, he did as much work under the warm as under the cool conditions. However, in another experiment where both temperature and humidity were high (86° F. and 80 per cent humidity) there was a *diminished inclination* to do mental work. It was found further that the more devoid the activity was of a muscular component the less it seemed to be affected by atmospheric conditions. "Purely mental work

may be considered as perhaps furnishing a certain amount of distraction under uncomfortable atmospheric conditions, but as soon as heat-producing muscular work is involved the scale tips the other way." Although the report recommends that these studies be repeated over a much longer period of time, because the rise in body temperature and changes in the circulation of the blood might have some cumulative effects upon mental activity that do not manifest themselves in a short time, the findings on the whole were considered negative. The concluding paragraph of the report is as follows (*659,* 126):

> It may be that the custom of relaxing or intermitting mental work in response to hot skin, flushed face, perspiring body, and the like gives no evidence that mental work is any more taxing or injurious than at cooler periods. The higher body temperature, circulatory changes, and sensory discomforts probably are taxing, but we lack evidence that their presence makes the same mental productivity different in its nature or consequences from what it is in cool air. The discomforts to which men have responded by ceasing mental work might perhaps better be responded to by working to pay for an electric fan, taking cool baths, or thinking out ways to reduce the physical exertions which accentuate the discomforts. Merely to postpone useful thought to a cooler period may leave the net total of discomfort unchanged or even increase it.

The bare possibility still remains that subjects under such circumstances could and did maintain a steady pace by reference to some criterion not at once obvious. If this were the case, it should show in terms of increased effort such as Morgan, Davis, and others have detected (Chapter 7). The most direct evidence of such effort would be increased muscle tensions or a heightened metabolic rate. The experiment did include metabolism measurements under the various conditions, but the results are reported as inconclusive because of inadequate control of all other circumstances affecting metabolism.

THE INFLUENCE OF ATMOSPHERIC CONDITIONS UPON THE FEELINGS

Reference has already been made to the variations in the inclination to work under the different atmospheric conditions. Therefore, it may be pertinent to inquire concerning the effect of such conditions upon the feelings, since satisfaction stands in its own right as one of the legitimate products of activity (Chapters 1 and 24).

The subjects in these experiments were allowed to grade their feelings from time to time according to a five-point scale whose extremes were as follows:

5. I feel as comfortable as I ever do, or nearly so.
1. I feel as uncomfortable as I would with a severe headache or an attack of the grippe.

The intermediate steps on the scale were:

3. I feel about as I usually do at the close of an afternoon of hard mental work.
2. I feel about half way between 1 and 3.
4. I feel about half way between 3 and 5.

When the feeling records for all the subjects whose output is shown in Table 18 are combined, they are as given in the first row of Table 20. The records for a second five-weeks period under essentially the same conditions are shown in the second row of the table.

TABLE 20

EFFECT OF ATMOSPHERIC CONDITIONS UPON THE FEELINGS *

Temperature	68° F.	68° F.	86° F.	86° F.	86° F.
Humidity	50	50	80	80	80
Air supply	Fresh	Recir-culated	Recir-culated	Fresh	Recir-culated
Fans	No	No	High speed	No	No
First five weeks	3.6	3.9	3 2	3 0	2 5
Second five weeks	3 8	3.8	3 2	..	3.0

* Adapted from *Ventilation,* Report of the New York State Ventilation Commission (New York, E. P. Dutton and Co, 1923), pp 99-100.

On the bad days the authors report that there was a tendency toward "sleepiness and depression." Gauged by the usual standards of mere physical well-being, the general comfort was greatly reduced. And, finally, the difference between good and bad conditions "is that of comfort and satisfyingness and not that of quantity and quality of product produced."

In dealing with the effects of atmospheric conditions upon performance and upon the feelings in particular there is a range of individual preference which makes perfect adjustment of all persons difficult if not impossible to attain. The extent of these differences is measured by Bedford (*34*). He employed a comfort scale of seven steps, as follows:

Step 1 Much too warm
Step 2. Too warm
Step 3. Comfortably warm
Step 4. Comfortable
Step 5. Comfortably cool
Step 6. Too cool
Step 7. Much too cool.

The distribution of some 2,000 persons giving about 3,000 observations is shown in Table 21 for the temperature considered "comfortable" and for that considered "comfortably cool to comfortably warm." The figures represent the percentage of persons reacting in either one of these two ways. One's everyday experiences among people will readily confirm the extent of the differences recorded in this table.

TABLE 21

INDIVIDUAL DIFFERENCES IN PREFERRED TEMPERATURES *

Temperature in Degrees Fahrenheit	*Per Cent Reporting*	
	Comfortable	Comfortably cool to comfortably warm
54 to 55 9	28	67
56 to 57 9	46	76
58 to 59 9	58	80
60 to 61 9	77	88
62 to 63 9	84	91
64 to 65 9	78	92
66 to 67 9	69	87
68 to 69 9	60	88
70 to 71 9	45	83
72 to 75 9	45	61

* From T Bedford, "The Warmth Factor in Comfort at Work," *Indust Health Res. Bd*, 1936, No 76, p. 23.

THE INFLUENCE OF CLIMATE UPON EFFICIENCY

Climates differ one from another, and seasons likewise, in four respects, namely, temperature, humidity, barometric pressure, and wind. The influence of climate and season of the year, consequently, reduces largely to a question of temperature and relative humidity. Some consideration must be given to the statistical researches upon the influence of climate and season, if only to corroborate the experimental results on temperature and humidity. Aside from the method of obtaining the data, the study of ventilation and of climatic conditions differs in that the latter is concerned with the results of subjection for long periods of time to certain atmospheric conditions, and the former with results for relatively short periods. The supposed effects of climate upon civilization are thus summarized by Dexter (*136*, 74, 78).

In their effects upon the race ... varying temperatures have been recognized by every student of climatology. Inhabitants of hot climates are apt to be listless, uninventive, apathetic, and improvident. An equable high temperature,

especially if moist, weakens body and mind. No long-established lowland tropical people is a conquering race in the broadest sense of the word For the inhabitants of the higher altitudes, even under the tropical sun, this may not be true; for as we ascend, the temperature lessens about 1 degree every 270 feet on an average, and even at the equator we may have a temperate climate The most favorable temperature for health that carries with it an aggressive energy which is felt, and which has led the world march of civilization, is about 55 to 70 degrees Fahrenheit, on an average, and this is found in the temperate zones.... The dominant peoples are found between the latitudes of 25 and 55 degrees Farther north the available vital energy seems so largely expended in furnishing mere body heat and stimulus for the necessary physiological functions that there is little left for use in those activities which make leaders.... Excessive heat together with high humidity forms a most deadly combination for one not acclimated to it, as the mortality on the west coast of Africa testifies; while in some localities, as for instance, Western Ireland, the lake region of England, and the extreme northwestern coast of our own country, much moisture from a great rainfall without excessive heat is not particularly unhealthful.

One objection to attaching such great importance to climatic conditions in determining the character of civilization has been the changes in the type of civilization that have taken place in the course of centuries in the same locality (*305*). To offset this objection, however, there is the suggestion, supported by modern researches, that climatic conditions have varied from century to century, and that

When the great countries of antiquity rose to eminence, they enjoyed a climatic stimulus comparable with that existing today where the leading nations now dwell In other words, where civilization has risen to a high level the climate appears to have possessed the qualities which today are most stimulating.

So far as the behavior of the individual is concerned, climatic conditions which are extreme in neither direction are conducive to the greatest activity. That is, in extremely warm and humid climates and in extremely cold climates, the excess of energy supply over demand is always slight, and activity of all kinds is at a minimum. To put the matter another way, so as to relate it to our study of ventilation more closely, any atmospheric conditions which tend to change the body temperature much above or below its normal for more than a very short period of time decrease activity.

It must be remembered that great activity and the large reserves on which the activity depends may be turned to good or bad use. Thus Dexter (*136*) attributes the excess of crimes such as murder and assault in the temperate zone, over that in the torrid or frigid zone, to this excess of energy and consequent activity. He also finds a great excess of such active crimes as assault in the summer months as compared with the winter months. On the other hand, he finds much more drunkenness in the winter season, a condition which he attributes to the low state of

energy and the consequent need for stimulants. Excess of activity seems to find the readiest escape by way of the emotional states that lead to fighting.

Dexter (136) measured the effect of season of the year upon intellectual work of a rather specific sort, namely, the calculations of bank clerks. The records were in terms of certain types of errors. He found most errors occurring in October, November, and December and fewest in April, May, and September, with the number fairly large in the hot summer months. The last he considers a result of the depletion of energy from excessive heat; the good records, or few errors, in the spring and autumn are attributed to the stimulating character of the changes in temperature. The high error record in the winter months cannot be attributed to weather conditions solely, as the whole matter is complicated by increased business and holiday seasons.

Interest in the long-term effects of climate and climatic changes has recently been revived by Wheeler (*698*) (*699*) who is making a survey of history from 600 B.C., in a search for correlations between climate and the behavior of peoples. He has reported a relationship between fluctuations of climate from warm to cold and fluctuations of forms of government from totalitarianism, absolutism, and socialism to democracy and individualism.

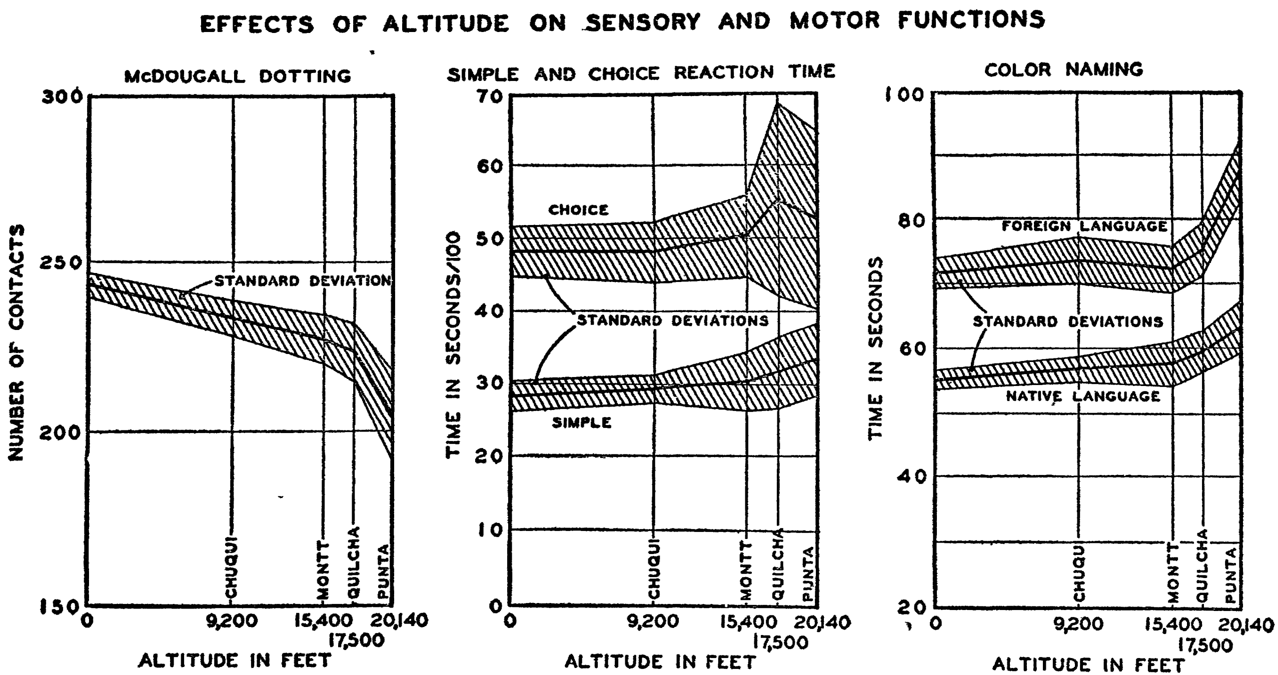
EFFECTS OF HIGH ALTITUDES UPON BEHAVIOR

Barometric pressure which changes with altitude is coming to be recognized as one of the most important of the many conditions comprehended within the term climate. Research upon the physiological functions as they are affected by living in high altitudes and by climbing into high altitudes has been under way for many years. Interest in the problem has been intensified because of the trend of aviation toward extremely high altitude flying even for commercial purposes. Mental processes have come to receive a share of the attention because the effect of high altitudes upon them could not long escape the attention of observers. A significant factor in the changes noted, if not the most significant factor, is the reduction in atmospheric oxygen. The barometric pressure at an elevation of 18,000 feet has fallen to one-half that at sea level. Since the proportions of the various gases in the air do not change, it will be obvious that a given quantity of inspired air will contain only half the normal amount of oxygen.

The various physiological and psychological effects of altitude have been studied while climbing high mountains such as the Andes, while residing there, while ascending in airplanes, and while undergoing a decrease in oxygen supply in a sealed experimental room.

FIGURE 51

THE EFFECT OF HIGH ALTITUDE UPON MENTAL FUNCTIONS *



* From R. A McFarland, "Psycho-Physiological Studies at High Altitudes in the Andes," *J Comp. Psychol*, 1937, *23*, 247.

McFarland (*413*) (*414*) (*415*) (*416*) reports that sudden ascent to 16,000 feet by plane and slower ascents by train to about the same elevation impair both simple and complex psychological functions. A few samples will show the nature of the changes which occur at high altitudes after a period of adjustment. Figure 51 shows the effect of altitudes up to 20,140 feet upon simple and choice reaction time, upon color naming, and upon the high speed coördinated responses required by the McDougall Dotting Test. The critical elevation for these functions is in the neighborhood of 16,000 feet. The vertical and horizontal scales are clearly marked. The shaded area surrounding each curve indicates the standard deviation of the measures. It should be recalled that these results were obtained after a partial acclimatization. The effects of a rapid ascent in a plane to 15,000 feet, not an unusual height today, would be much more pronounced.

THE INFLUENCE OF WEATHER UPON EFFICIENCY

Weather may be reduced to the same four conditions as climate, namely, temperature, humidity, barometric pressure, and wind, the main difference being in the temporary character of weather conditions as compared with climatic conditions. On account of this fluctuation in the weather, greater opportunity is offered for a study of efficiency. Climate is always involved with such a large number of other conditions, among them racial heredity, that conclusions are uncertain. The influences of the weather may be studied upon the same individuals under environmental conditions identical except in regard to this one factor.

The effects of weather upon mental and motor performance can only be determined by careful experimental and statistical studies. The work of the New York State Ventilation Commission illustrates the former. The statistical approach is well illustrated by the investigations of Huntington and Dexter. Huntington (*304*) studied more than 500 factory workers in Connecticut and 3,000 to 4,000 operatives from the southern states. He has examined the records of 1,700 West Point and Annapolis students and correlated their work on various days with the weather conditions on those days. His conclusions are as follows:

1. Changes in barometric pressure have little effect.
2. Humidity possesses a considerable degree of importance.
3. Temperature is the most important factor.

The greatest physical activity occurs when the daily temperature averages 60° to 65° F., with a noon temperature of about 70° F. Mental activity reaches a maximum when the outside temperature

averages about 38°, that is, when there are frosts at night. Moderate temperature changes from day to day are most conducive to activity, whereas great uniformity or sudden great changes are detrimental to good work.

The measurements of Dexter (*136*) on the effects of the season of the year upon the calculations such as bank clerks are called upon to make, and discriminations, or tests of speed of perception, are of interest in connection with the discussion of weather conditions. His results will be briefly quoted, although it must be clear that the conditions studied reduce primarily to those that were investigated by the Ventilation Commission. The latter work done under controlled conditions and with carefully planned technique should be given at least equal weight in drawing conclusions.

1. Increase in temperature causes an increase in errors, the increase becoming very rapid when the temperature reaches 85 degrees to 90 degrees F. At this point the excess reaches 60 per cent of the average.

2. Increase in barometric pressure increases the number of errors. Here the data are not so satisfactory and the conclusions rather indefinite.

3. High humidity, especially when accompanied by high temperature, causes increase in the number of clerical errors.

4. An increasing high wind causes a decrease in number of errors. Dexter's (*136*, 238) explanation of this conclusion is as follows:

> It seems to me probable that it is an evidence of the necessity of ventilation on a large scale, such as is caused in our large cities through great movements of the wind. Such movements bring fresh air from the surrounding country to take the place of that which has been deoxygenated through combustion of all sorts, and the effects which we have shown are just what might be expected, for that oxygen is necessary to mental alertness no one can doubt.

5. The effects of the general character of the day are of interest. Cloudy days are accompanied by greater inaccuracy and rainy days show the same effect. Answers to a questionnaire led Dexter to conclude that the best mental work is done on fair days, and many bank officials are said to have observed an increase of errors in unpleasant weather.

After this consideration of the data, it seems fair to reduce climate, seasonal, and weather conditions to the two conditions of temperature and humidity. Winds, and barometric pressure in its causal relation to winds, affect the body much as stirring the air of an enclosed room, by facilitating evaporation and heat radiation, with the consequent lowering of the body temperature.

RHYTHMICAL VARIATIONS IN EFFICIENCY

The probability of the existence of some kind of fundamental rhythm in human functions has led to a multitude of investigations of varying quality. Evidence has been sought for a diurnal rhythm (*186*) and more recently for a nocturnal rhythm (*329*). The testimony of individuals and the results of numerous early studies of work done at different times of the day created the impression that there are rhythmical variations in efficiency that can be capitalized. The equivalent of such rhythms of performance has been sought in changes in body temperature, pulse rate, breathing, and blood pressure. For instance, temperature, pulse, and breathing rate are said to be lowest in early morning, 5 A.M., and increase gradually reaching a maximum about 5 P.M. The death rate at various periods of the day has been taken as an indication of changing vitality or efficiency of the bodily mechanism. It has been a rather common opinion that death, excluding accidental death of course, is most frequent at the early morning hour, 4 A.M., and consequently it has been assumed that vitality must be lowest at that time. As a matter of fact, careful study of death statistics shows that the lowest death rate occurs in the early morning and the highest rate in the afternoon hours from 2 to 6, just when the physiological activities seem at their maximum. Other factors besides the bodily rhythm must, therefore, be sought as the cause of the peculiar distribution of deaths during the day.

Efficiency of the motor and mental processes at various periods of the day was studied by Marsh (*395*). In the case of physical strength, not including endurance, the minimal efficiency occurs at the extremes of the day, with a point of high efficiency about 11 A.M., and a point of maximal efficiency from 3 to 5 P M. As to rate of movement there is a gradual increase in efficiency during the course of the day with a maximum toward night. In accuracy of movement the maximal efficiency occurs toward noon. Increased nervous state during the course of the day would account for the increase of speed and the decrease of accuracy.

An interesting difference appears whenever mental activity is involved. When the motor activity is combined with mental work as in reaction-time and form-board tests, the course of efficiency follows that of the motor processes, with speed reaching a maximum late in the day, and accuracy in the late morning hours. In the more strictly mental activities, such as memory, translation of foreign languages, attention, discrimination, mathematical calculation, and school examinations, the highest efficiency is attained in the morning hours for both speed and accuracy.

A large number of adult students and authors were questioned by Marsh (*395*) concerning the time of their maximal efficiency, and the majority considered it to be the morning hours. Preference of working hours, however, may represent largely the influence of habit, rather than any actual difference in efficiency. Students attending classes constantly during the day may get the habit of working at night and feel less efficient at any other time. Individual choice of working hours may be further influenced by such factors as age, sex, and fatigue.

Gates (*201*) measured a variety of functions in a group of school children, where environmental factors were more uniform than in the case of Marsh's subjects. His conclusions in general support Marsh. It should be noted that the highly uniform school life could create a rhythm of performance in the children that would resemble one resulting from an underlying organic rhythm.

Such differences of efficiency in the course of a day, if established beyond question, would be of considerable value for practical work. Perhaps the most direct application can be seen in school programs where mental work would be done best in the morning hours and motor activities best in the afternoon hours. But many applications of the facts might be made to industrial activities also. A test of the output of magazine stitchers (*395*, 33-34) whose work is motor, with speed an important factor, showed that in the early morning hours the productivity was about 6 per cent below the average for the day, and 10 to 12 per cent below the maximal efficiency for the day, which occurs toward late afternoon. Thus if the working day of magazine stitchers were to be shortened, it should be shortened at the morning end of the day where efficiency is lowest. Data concerning the daily work curves in industry and the effects of shortening the work day are presented in Chapter 23. Figure 99, page 429, should be examined as it is the typical form taken by daily output curves in a great variety of industrial operations.

CAUSES OF DIURNAL RHYTHM

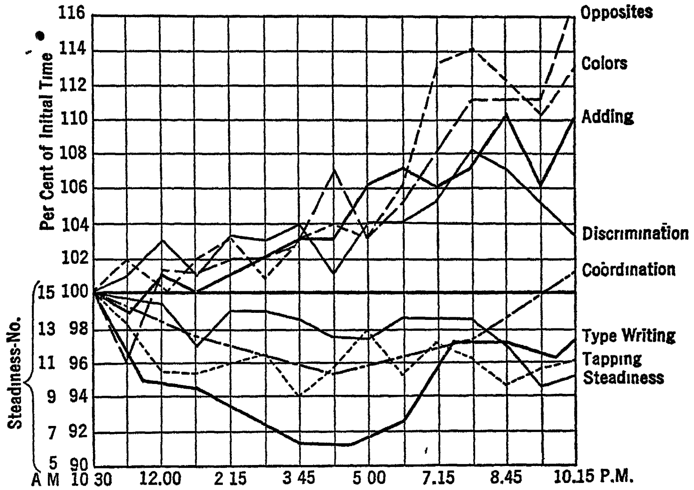
Is this rhythm of efficiency discussed in the preceding paragraphs owing to the nature of the physiological mechanism or is it owing to the relation between the hour of the day and the amount of work which has been done up to that time? In other words, is this daily efficiency curve after all only a work curve? The tests made by Hollingworth (*278*) upon ten individuals for a period of ten days, two days of which consisted of twelve hours each day of practically continuous work, offer the best material for answering this question. His general conclusion is that the efficiency at any period of the day depends not on

any organic rhythms, but rather upon the amount of work or activity which has preceded that period. For when the work begins at 10:30 A.M., the same sort of curve of efficiency for the day is obtained as when it begins at 7:30 A.M., except that it is shifted along just that much. One could scarcely expect that the rhythmic organic processes could thus shift.

Figure 52 contains average curves for all the persons tested. The kind of work is indicated on the right of the chart and the time of day on the horizontal scale. The vertical scale indicates the time

FIGURE 52

CHANGES IN EFFICIENCY DURING CONTINUOUS WORK *



* Adapted from H L. Hollingworth, "Variations in Efficiency During the Working Day," *Psychol Rev*, 1914, *21*, 479.

required per unit of work, expressed in terms of percentages of the first test. None of the functions represented here shows the variations commonly seen in industrial work curves (Figures 33 and 34). The difference is due mainly to the powerful stimulus to good records under which Hollingworth's subjects worked, and which are absent in the routine daily activities of the industrial worker.

The contrast between the period of maximal efficiency for motor and mental activity appears in Hollingworth's, as in Marsh's results. The data show further that subjects doing work essentially mental in character and working under uniform conditions, with a maximum of interest and incentive, show an average decrease of 10 to 15 per cent from the maximal efficiency in the course of a day's work. This result appears only after the possibility of improvement by practice has been

eliminated. The experiment made by Hollingworth is virtually the only one of its kind covering a long period of time which eliminates the complicating factor of practice effect, and consequently considerable value must be attached to his conclusions.

After a period of years following the work of Hollingworth during which his findings appeared to have disposed of the matter of a fundamental organic rhythm, the problem was reopened by Freeman (*183*). He conducted an elaborate series of researches upon performance and energy expenditure at different times of the day. His results reinforce the conclusions of Hollingworth which have just been reviewed, as shown in the following quotation (*183, 27*):

> It would seem that variation in performance and energy expenditure which correspond with the time of day are resultants of a complex polygon of forces, including food ingestion and sleep, effort and incentive, exercise and fatigue. The way in which these factors are arranged in relationship to the periods of work surveyed determines the form of variation which is exhibited . . . Thus, if one individual works most efficiently at noon and another at 5 P.M., it is probable that the two are following a different routine and that the conditions mainly responsible for the period of high efficiency are similar in both and independent of the hour surveyed.

The results of these various investigators from Marsh to Freeman demonstrate the importance for the individual of establishing the proper habits of living. No organic rhythm will interfere with an efficient program of working, resting, eating, and sleeping. Idiosyncrasies of daily routine should be explained as the result of habits of living and, where these habits are obviously inefficient, they can be revised toward a higher order of performance.

10

Monotony: A Problem in Adjustment

Some explanation may be needed to justify the selection of monotony for special consideration out of the many aspects of adjustment that deserve examination. Justification may be found in the prominence given to it in discussions of human efficiency in recent years, in the ill effects which are commonly attributed to it, and specifically in the dissatisfaction which it is alleged to cause. This last reason alone would seem to warrant careful consideration by the psychologist who looks upon satisfaction as a legitimate end-product of work.

There seems to be general agreement that the modern organization of business and industry has heightened the monotony of work. Just what it is in modern methods which is responsible is a matter of controversy. According to one point of view, monotony arises from the fact that heavy manual operations are now done by machinery, leaving to the worker only the light and dexterous work with the result that the mental effects are becoming relatively more important than the bodily effects. According to another view, monotony results from the complete separation of manual work from brain work so that the person who does the latter appropriates all the interest that is wrapped up in industry and leaves nothing to the worker but monotonous toil. According to still another view, it is the result of repetition of a highly specialized set of operations, and it makes no difference whether these are manual or mental. Finally, monotony is looked upon as a purely subjective condition and not as a characteristic of the work at all. It depends upon the nature of the individual and need have no relationship to repetitive work, or to the limitation of function to either physical or "mental" operations (*126*).

THE CONCEPT OF MONOTONY

Each of these statements describes some aspect of monotony. It is sometimes present in routine manual work and sometimes in routine mental work. A game of bridge may be experienced as monotonous

although repetition and routine are at a minimum. Furthermore the very same game of bridge may be monotonous to one of the players and not to another. What then is monotony?

Some order may be introduced into these seeming contradictions by reference to the phenomena of attention and distraction as discussed in Chapter 7 and further demonstrated in Chapters 8 and 9. It was said there that a waking person is always attending to something and that there is a natural tendency for attention to fluctuate or flit from one object to another. Whether this phenomenon of fluctuation is due to temporary blocking of the conducting mechanisms within the central nervous system is not known. It is tiring or fatiguing to resist this tendency to fluctuate. Such resistance implies an inhibitory process which is not a purely subjective phenomenon, but is a struggle between motor mechanisms for the control and direction of behavior. When the movements of attention are artificially restricted by the devices of the hypnotist, the patient will fall asleep. When not under such artificial control, constant attention of a limited sort is boresome, wearisome, monotonous. Innumerable objects are competing for the attention. Some of them are called distractions if, for any reason, they are not appropriate objects of attention. We have shown already that resistance to such distractions, whether they are lights, sounds, odors, contacts, or what not, means the expenditure of effort.

The competition for attention that occurs under ordinary circumstances is between what one *wants* to attend to and what one *ought* to attend to. The wants are to be inhibited in favor of the "oughts." To maintain attention upon a routine task when the mind is drawn toward more pleasing objects, memories, or imaginings means the exertion of effort and the expenditure of energy. Where the need is great, as in tending a rapidly revolving and dangerous machine so that fluctuations of attention might cause an accident, the inhibition of the distractions soon becomes wearisome. The task has become monotonous. On the other hand, where needs and desires coincide exactly, monotony should be entirely absent. According to this interpretation, resisting the distraction of a bright light (Chapter 8) when reading should give the same sort of irritation, restlessness, and weariness that results from resisting pleasing memories, day dreams, or other powerful competitors for attention while working. Such seems to be the case. Monotony might, therefore, be called a manifestation of a general state of weariness which results from resisting a particular class of distractions.

Dodge (*140,* 111-112) has analyzed the phenomena of monotony into two fundamental physiological processes of competition among conduction paths in the nervous system and of the refractory phase of nerves. He says:

Most normal lives seem too full of competing tendencies. In my own case I have been interested in observing how every prolonged period of monotonous work like correcting papers, for example, finds before its close some insistent demand for interruption If I successfully suppress one demand, more insistent ones arise, until finally effective voluntary reinforcement of the main task suddenly ends. The voluntary reinforcements may have developed such sensations of strain that the surrender to a competing impulse brings great relief.... I suppose all the phenomena of restlessness and the corresponding attractiveness of change reduce to competition and the relative refractory phase. They operate in work and play, in social and economic activities, in politics and religion.... Without their interference the initial process must always work itself out to the final collapse of complete exhaustion.

Myers (*456*) expressed the same idea when he described the effects of monotony in terms of competition for the control of behavior. Competing mental activities, he said, refuse to remain suppressed. They intrude and make continuance of the monotonous work impossible. The effort to repress the intruding activities is accompanied first by "a feeling of boredom as interest wanes and later by a feeling of weariness as the effort is invoked with greater difficulty."

Robinson (*522, 97*) adds two additional points to the statements of Dodge and Myers, that the strain and dissatisfaction may appear before any noticeable falling off in quantity or quality of output, and that the feelings of dissatisfaction may be resisted under certain circumstances to the point where there is danger of exhaustion. He would, therefore, like Dodge, attach some protective value to the feelings of boredom, though cautioning against too ready response to the danger signals of overwork.

The tentative conclusion may be drawn from this brief survey of opinions that monotony is a condition created by competition for control of the reacting organism, characterized by tension and strain with feelings of weariness, and an eventual reduction in the quality or quantity of work or both.

One further question may be asked in the light of the findings concerning distraction. Is the resistance to competing stimuli, especially during the period when output does not fall, accomplished at the cost of increased expenditure of energy? If the phenomena of monotony are related to those of distraction, as the discussion thus far implies, then the answer to this question may be expected to be positive.

THE EFFECTS OF MONOTONY

Barmack (*25*) administered a program of laboratory experiments which should give at least tentative answers concerning output, energy expenditure, and feelings. One of three forms of performance

was required of the thirty-nine subjects taking part in the experiment namely, operating a Pursuit Meter continuously for 70 minutes, addir pairs of six-place numbers for 90 minutes, and taking a series of fi\ forms of an intelligence examination requiring a total of 90 minute These three tasks were selected by Barmack for study in the hope th: they would be boring, neutral, and interesting respectively. Energ cost was measured by means of the technique described on page 11 which employed rate of oxygen consumption as the critical measur The state of mind of the subjects with reference to boredom, strai irritation, sleepiness, and attention was measured by means of the cu: tomary type of rating scale. The monotony scale, and the strain scal are given below:

1	2	3	4	5	6	7	8	9	1
Very bored		Bored		Indifferent		Interested		Very intereste	

1	2	3	4	5	6	7	8	9	1
Very relaxed		Relaxed		Indifferent		Strained		Very straine	

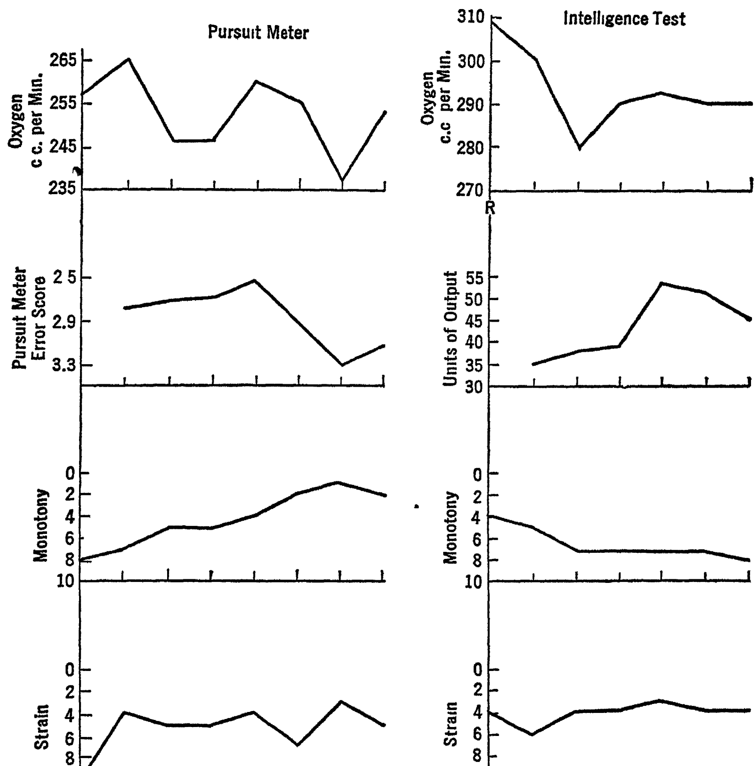
Each scale consisted of ten steps. The descriptive terms underneat the scale were not intended to be directly related to the specific step: but were meant rather to show the direction of change in the cond tion. These scales are subject to all the criticisms that are customaril leveled against rating devices, but when used for recording change within a given individual they have some utility.

One complicating factor arose early in the experiments so far a energy expenditure was concerned. To illustrate with an extreme cas suppose that the monotony of the work became so extreme that th subject, overcome with weariness, went to sleep. His energy cost woul naturally be reduced in the sleeping state. In less extreme cases the or set of weariness would tend to lead to reduced output with a consequen reduction in energy expenditure. In fact just this result should occu according to the hypothesis outlined above. Only where the distractin power of the monotonous task was resisted and performance kept u to a given level in spite of it would the energy cost per unit of wor be expected to increase. This latter condition resembles somewhat th state of affairs that would be encountered in industry where a worke is more or less under compulsion to maintain his output in spite o boredom. He cannot, however, invariably do this, in spite of his effor as is indicated in the daily curve for monotonous work shown in Figur 34, page 120.

It was Barmack's expectation that the repetition of the intelligence test would be uniformly interesting to all his subjects and that the Pursuit Meter would be boring. This was not the case, however, since all tasks tended to be monotonous. The situation was complicated still

FIGURE 53

COMPARISONS OF INTERESTING AND BORING TASKS*



* Adapted from J E Barmack, "Boredom and Other Factors in the Physiology of Mental Effort," *Arch Psychol.* (New York), 1937, No 218, Figs 3 and 14

further by the great individual differences in the attitudes of his subjects. He did not have, therefore, two clear-cut classes of cases, the interested and the bored group, upon which to make his measurements. As he was interested in the general physiological condition under boredom he did not drive his subjects to maintain a given output level. Two cases selected from his data are presented in Figure 53. One gives the

records of a subject working on the Pursuit Meter, and the other of a subject taking a series of intelligence examinations. These two records were chosen because they demonstrate increasing monotony in the one case and increasing interest in the other. In addition to the monotony curves, there are curves of output, of oxygen consumption, and of strain. In the Pursuit-Meter records the base line represents the resting period before work at the end of which the metabolic rate was measured, followed by seven work periods each 10 minutes in length. In the intelligence-test records the base line represents rest followed by six periods each fifteen minutes long. Inspection of these two sets of curves shows that as monotony on the Pursuit Meter grows, the performance tends to decline (increase of errors), and as interest grows in the intelligence test, performance rises (output). The curves of metabolism and of strain show no clear-cut trend. Any interpretation of the metabolic curves is complicated by the fact that the resting metabolism is higher than at any stage of the actual work in the intelligence-test curve, and higher than the majority of points on the Pursuit-Meter curve. Such results are not unusual and suggest a relatively high state of tension in the pre-test situation where so far as output of useful work only is concerned, the subject is resting.

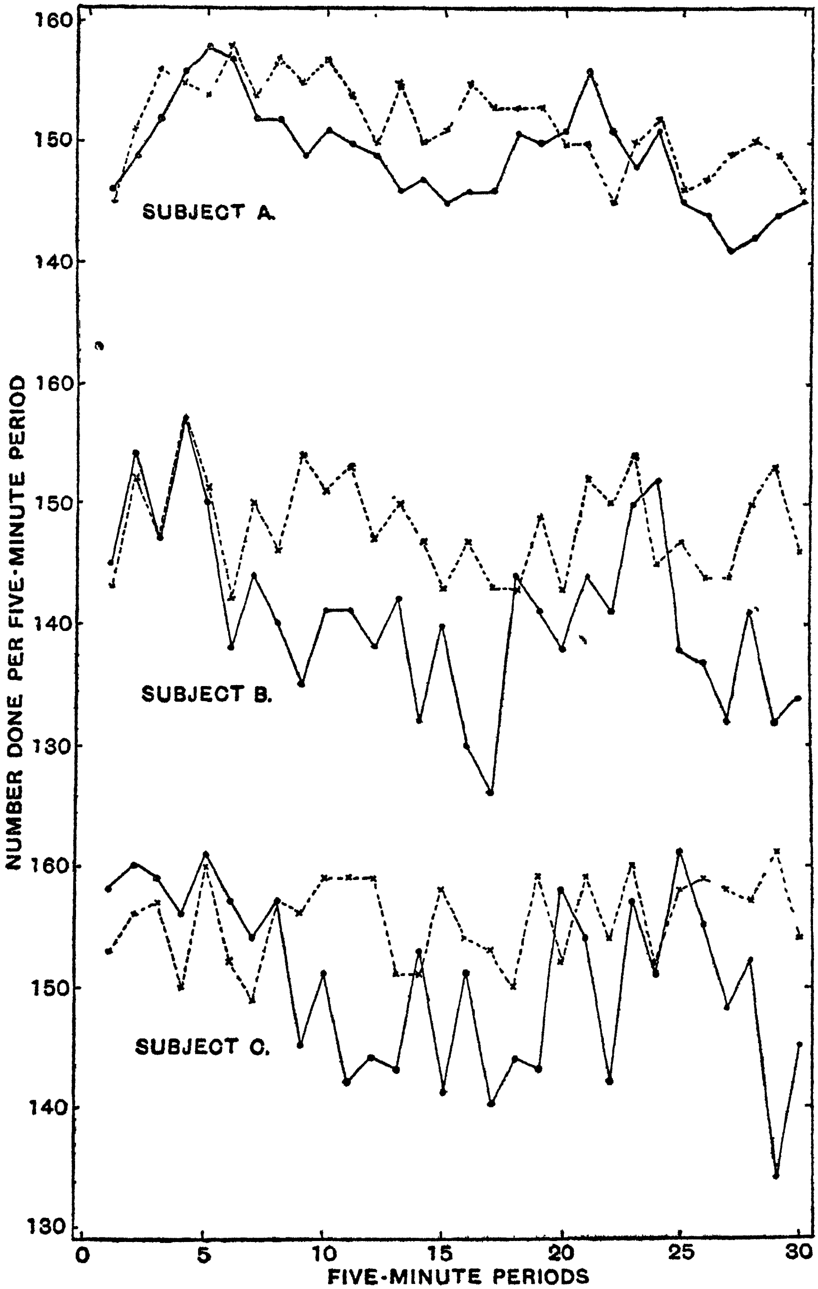
Other laboratory studies generally confirm the relationship between output and boredom reported by Barmack. It is clearly shown in the experiment of Wyatt and Fraser (*727*) who had subjects assemble bicycle chains under experimental conditions and called for introspective reports concerning boredom. Three of their cases are shown in Figure 54, in which the broken line gives the output record where boredom was "almost absent" and the solid line where boredom was experienced. The vertical scale gives the number of units of output per five-minute work period, and the horizontal scale shows the thirty five-minute periods. Subject B began to feel bored after the first 25 to 30 minutes which represents the point where the two curves begin to diverge. Boredom decreased at about 100 minutes when the end of the work spell was believed to be near, and increased again when the stop signal was not given. The output is affected in each case. Interpretations parallel output similarly in the case of Subject C.

The same authors have described the relation between output and boredom in actual industrial operations. The records of two subjects have been chosen to illustrate their results. The work consists of the insertion of the filaments in light bulbs. Worker F is bored by the work and to the greatest degree in the middle of the work spell. Worker M "finds the work all right," but begins to get bored at about 4 to 5 P.M.

FIGURE 54

MONOTONY IN AN ASSEMBLY TASK *

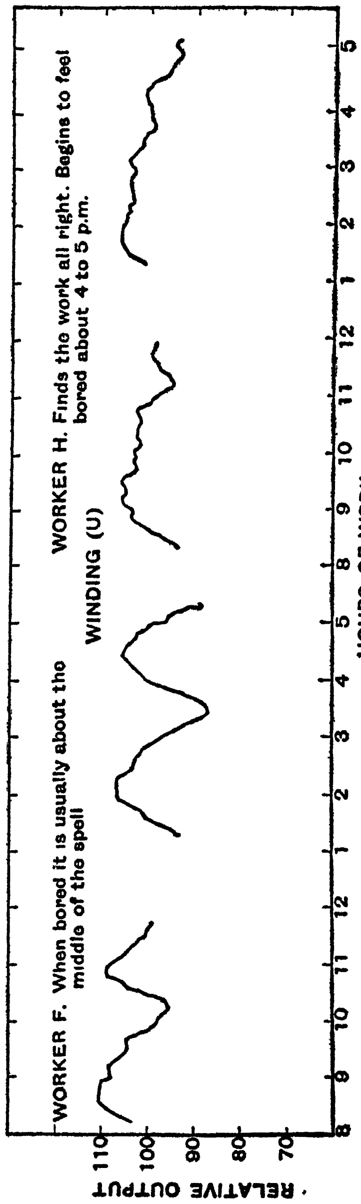
Continuous Line Shows Boredom and Broken Line Shows Little or No Boredom



* From S Wyatt and J. A Fraser, "The Effects of Monotony in Work," *Industr Fat. Res. Bd.*, 1929, No 56, 10

FIGURE 55

RELATION BETWEEN OUTPUT AND BOREDOM IN AN INDUSTRIAL OPERATION *



* From S. Wyatt and J. A. Fraser, "The Effects of Monotony in Work," *Industr. Fat. Res. Bd.*, 1929, No. 56, 13.

Figure 55 gives the smoothed curves for a composite work day for these two workers. The vertical scale shows relative output above and below a standard at 100; the horizontal scale indicates the hours of work. Output will be seen to conform to the state of feelings.

INDIVIDUAL DIFFERENCES IN SUSCEPTIBILITY TO MONOTONY

Individual differences in susceptibility to monotony should be anticipated both on theoretical grounds and from the results of the researches reported here. Just as in the case of distractions, monotony comes from the interaction of an individual with a given set of circumstances. Each individual with his own unique characteristics is one of the determinants. Wyatt and Langdon (*726*) made a quantitative estimate of these differences. They developed an index of boredom or monotony, from the answers to a set of thirteen questions. The reply to each question is given a value on the following scale:

0—1	Practically free from boredom
1—2	Slightly affected by boredom
2—3	Moderate degree of boredom
3—4	Suffered severely from boredom
4—5	Never free from boredom

The index was the average of the score assigned to all the answers. The distribution of the amount of boredom in terms of the percentage of a given group of persons experiencing each degree is shown in Table 22. Workers from four different factories appear in the table. First the

TABLE 22

INDIVIDUAL DIFFERENCES IN SUSCEPTIBILITY TO MONOTONY *

Factory	*No in Group*	*Degree of Monotony*				
		0—1	1—2	2—3	3—4	4—5
A	142	1	26	43	28	2
B	102	3	42	37	16	2
C	81	5	39	33	19	4
D	30	3	13	37	30	17
Average..		3	33	38	23	3

* From S Wyatt and J. N Langdon, "Fatigue and Boredom in Repetitive Work," *Indust Health Res. Bd*, 1937, *77*, 5

factories are indicated by the letters A to D. Then the number of cases from each factory is given. This is followed by five columns representing the various degrees of boredom. At the bottom of the table is the distribution for all the factories in terms of the percentage of the total number of cases. These figures show that the workers within a given factory experience all the degrees of boredom from practically none to continuous boredom

Even more striking are the data given in Table 23, page 196, which are reproduced primarily for another purpose. In this table the monotony indices are given for ten workers every one of whom spent one month in each of a series of five occupations. The different occupations are shown along the top of the table and the ten workers are shown in the first column. Looking down any one column for a certain task one notes the extent to which the individuals differ in their attitude toward it. Thus in making crackers the boredom varies from practically none (1 0) to nearly continuous boredom (4 8). Bundling chocolates is the only task which seems to affect all persons fairly uniformly, with indices ranging only from 3.2 to 4.6.

The extent of the individual differences demonstrated by the data of Wyatt and Langdon and others raises an interesting problem in adjustment. It would appear that no task and no set of working conditions could be offered that would be interesting to all workers, although in Table 23 it is shown that some tasks and some working conditions are more likely to be satisfying than others. Proper adjustment would seem, therefore, to call for the selection of those persons for a given task who would be likely to be interested in it or who would at least not be bored by it. One might do this by evaluating the task for monotony-producing characteristics and by measuring individuals for their tendency to be bored.

The first of these two functions cannot be performed by mere inspection. Münsterberg (*442*, 197) cited an occupation which will appear to the reader to be extremely monotonous and in which a worker packed incandescent lamps in tissue paper. She wrapped them from morning to night, from the first day of the year to the last, and had been doing that for the previous twelve years. She performed this packing process at an average rate of 13,000 lamps a day. The woman had reached about 50,000,000 times for the next lamp with one hand and with the other to the little pile of tissue sheets and then performed the packing. Each lamp demanded about twenty finger movements. She was able to pack twenty-five lamps in forty-two seconds and seldom did she need as many as forty-four seconds. Every twenty-five lamps filled a box, and the closing of the box required a short time for itself. She evidently took pleasure in expressing herself fully about her occupation. She found the work really interesting, and constantly felt an inner tension, thinking how many boxes she would be able to fill before the next pause. Above all, she experienced a sense of variety in her work. Sometimes she grasped the lamp or paper in a different way, sometimes the packing itself did not run smoothly, sometimes she felt fresher, sometimes less in the mood for the work, and always found something to observe and something to think about.

In general it may be stated that simple, highly repetitive, and rapidly repeated operations are most likely to be monotonous and that those that are more varied, have a slower tempo, have frequent rest pauses, and allow for social intercourse are less likely to be boring. The questionnaire technique of Wyatt and Langdon just described offers one method of evaluating tasks in terms of the average level of monotony which they create in a population of workers. The limits of utility of such evaluation are clearly set by the range of individual differences within the worker population.

SPECIFICITY OF BOREDOM

One serious difficulty arises in the attempt to evaluate individuals for their susceptibility to boredom and that is the question of the specificity of the characteristic within the individual. Is there something in the constitution of one person that makes him sensitive to repetition and uniformity however and whenever it occurs, something that another person lacks? Münsterberg (*442*) posited such differences and accounted for them by the characteristics of the psychophysical organism. There are some persons, he said, for whom the receipt of a certain stimulus sharpens the attention for a repetition of that stimulus, whereas there are others for whom the receipt of such a stimulus dulls or inhibits the attention for a repetition of it. The former would tend not to experience monotony and the latter would experience it. Although this particular formulation is still a matter of theory, Münsterberg found some support for it in his laboratory experiments.

There are certain well-recognized differences among people that may have a bearing on their susceptibility to monotony, namely the ease or difficulty of shifting from one thing to another (Chapter 20). Some persons, when once they are "set" in a certain course, are hard to shake out of it, whereas others are notorious in their shifting of interests. Whatever the cause of these differences in attitude toward work may be, the differences themselves have frequently been reported by observers of industrial work.

Wunderlich (*721*), too, sought for something in the individual which made him a victim of boredom. On the basis of a test calling for repetitive, uniform work at high speed he classified his eleven subjects into three types. These were: (1) the "totality" type whose whole attention is concentrated upon the task in hand, and who has great difficulty in making any function automatic. In a mechanical job such a person experiences boredom. (2) An opposite type that falls into a motor habit quickly, and without the details of the experience intruding into consciousness. The task becomes purely motor, so that consciousness can

occupy itself with entirely unrelated matters. Such persons suffer no boredom. (3) An intermediate type.

If such constitutional types as those of Münsterberg and Wunderlich exist, monotony would have a degree of generality within the individual so that if he experienced boredom in one situation he would be very likely to experience it in others, too. Selection of boredom-free workers would then be feasible. It would seem, however, that the studies of neither Münsterberg nor Wunderlich would be calculated to establish the generality of the trait since individuals were not subjected to a sufficiently varied assortment of situations.

The data given in Table 23 which are taken from Wyatt and Langdon (*726*, 15) show a surprisingly high degree of specificity of sus-

TABLE 23

SPECIFICITY OF BOREDOM *

Workers	*Packing* (14 lb)	*Packing* (4 lb)	*Staying Boxes*	*Making Crackers*	*Bundling Chocolates*
A	04	15	19	40	42
B	07	11	20	4.8	46
C	35	40	1.1	18	43
D	14	25	16	37	48
E	10	03	2.1	34	3.2
F	11	19	47	10	4.4
G	09	05	32	03	4.1
H	32	26	3.0	1.2	45
I	08	15	1.6	20	38
J	36	10	1.5	19	40

* From S Wyatt and J. M Langdon, "Fatigue and Boredom in Repetitive Work," *Indust. Health Res. Bd*, 1937, *77*, 15.

ceptibility to monotony. Each of the five industrial operations was performed for one month by ten workers, and their degree of boredom estimated as described on page 193. The body of the table contains their indices of monotony. If one chooses any one of the workers designated by the letters in the first column of the table, and follows his record across the table through the five occupations, a range of variation will be apparent almost as great as the boredom scale will permit. Thus in making crackers, worker F had an index of 1.1, which means that he experienced practically no boredom, although in staying boxes he had an index of 4.7, which means that he was bored just about all the time. Other workers show similar wide fluctuations.

If susceptibility to monotony is so highly specific as the data of Wyatt and Langdon suggest, it would seem to be futile to seek for a test of the characteristic or to attempt to classify people according to their susceptibility. Such efforts as have been made to do these

things have had rather discouraging results (*613*). A relationship has been sought between intelligence and proneness to boredom and certain of the studies have offered some promise that intelligence might be a useful indicator. Burnett (*65*), for instance, found that the most intelligent of four laboratory subjects working upon a repetitive task was the most prone to boredom and the least intelligent of them was actually interested in the task (Chapter 24). Wyatt and Langdon, too, looked for a relationship between intelligence as measured by a five-minute test and the index of boredom obtained from their questionnaire study. They divided the workers into two classes, the most bored and the least bored, and computed their average intelligence scores. Although the intelligence differences between the classes was seldom significant, the investigators point out that in each of ten worker groups studied, the most bored class had the higher intelligence.

A similar procedure was followed in seeking a relationship between susceptibility to boredom and introversion-extroversion, this personality trait having been measured by a short questionnaire. In every case the most bored class showed an extroversion trend and in five out of seven cases the least bored showed an introversion trend. In only three out of seven cases was the difference statistically significant. It seems probable from these studies that in the long run there will be a slight positive correlation between boredom and certain personality characteristics, but it is very doubtful whether the relationship will be found to be close enough to warrant prediction of susceptibility to boredom from them.

PRACTICAL CONSIDERATIONS

From everything that has been said in this chapter concerning individual differences, specificity, and the conditions under which boredom is most likely to occur, it would seem advisable to take precautions against too great uniformity and repetition in work processes. The studies that have been designed to measure the effect of a varied as contrasted with a uniform work schedule generally show benefits from variety. All of the gain cannot, however, be attributed to a reduction in boredom since other aspects of the work may change at the same time. Nevertheless, within the over-all effect there does appear to be a decrease in monotony.

Such a study was made by Wyatt (*722, 24-37*) who had three persons perform three types of work with two different daily work schedules. The tasks were simple mental addition, addition by means of a comptometer, and a simple form of muscular work. The daily schedules which were followed for six weeks consisted of two two and one-half-hour work spells separated by one hour for lunch. On some days the

whole five hours were spent on one kind of work, whereas on others the work was changed every fifty minutes. In every case the variegated schedule gave both a greater output and a higher degree of accuracy, as shown in Table 24. Introspective reports from the subjects show that the unvaried work days were very monotonous and boresome and that the varied work days were far more satisfactory and enjoyable.

TABLE 24

EFFECTS OF CHANGE OF OCCUPATION IN SIMPLE MENTAL AND MOTOR WORK *

	Subject	Percentage of Increase on Varied Days	
		Output	Accuracy
Adding	A	24 2	26 1
	B	8 8	55.1
	C	10 6	25 1
Comptometer	A	12.7	43 4
	B	4 2	9 2
	C	18.2	27 9
Muscular	A	7.8	...
	B	2 4	...
	C	5.1	...

* Adapted from S Wyatt, "On the Extent and Effects of Variety in Repetitive Work," *Indust. Fat. Res. Bd Rep.*, 1924, *26*, 26-27.

These results are confirmed by Wyatt (*723*, 13-23) in a field study of output in the packing of drugs in a wholesale firm, in which two workers were observed over a period of several days. Three schedules were followed. The first, in which there were many changes, consisted in adjusting the work to the character of the small orders for drugs as they were received. Not only was there a variation in the commodity to be packed, but each operator gathered the drugs and packing material, and counted, packed, and wrapped each order separately. The second, in which there were few changes, involved a shift of occupation every half hour throughout the day. In the third schedule, the same work was done throughout the day. The relative efficiency of these schedules in terms of output is shown in Table 25, in which the records are in terms of the percentage of the lowest daily wage earned. This lowest wage was earned by Subject A in the day of many changes, which is given, therefore, a score of 100. It appears that a few changes are better than many changes, and that for one subject at least no change is still better so far as output is concerned. Naturally, some of the increased output results from the reduction in "unproductive" time spent in changing from one process to another. On the days of

many changes, this "unproductive" time amounted to about 20 per cent of the day. Some of the increase results also from speeding up the work process through getting into the "swing" of it. On the days when no changes were made, of course, the unproductive time was almost entirely eliminated. The speed of the work fell off sharply during the day, so that in the last two hours of work a unit of production required

TABLE 25

EFFECTS OF CHANGE OF OCCUPATION IN PACKING DRUGS *

	Percentage of Lowest Daily Earnings	
	Subject A	*Subject B*
No change	114.8	135 6
Few changes	117.3	120 3
Many changes......	100 0	100.9

* Adapted from S. Wyatt, "On the Extent and Effects of Variety in Repetitive Work," *Indust. Fat Res. Bd Rep.*, 1924, *26*, 17-18

19 per cent longer than during the first two hours. During these unvaried days the operators "often showed signs of discomfort, especially during the latter part of the afternoon spell. They appeared to be physically uncomfortable and frequently changed their posture." Checking the work curves against the introspective reports of the workers and the observations of the investigator led to the conclusion that unvarying repetitive work throughout the day was "conducive to fatigue, boredom, and monotony, and is disliked by the operatives. Although it enables the work to be done at times with greater rapidity and dexterity, the cumulative effects of fatigue and monotony almost neutralize these advantages."

It appears from these two studies, as well as from a more theoretical consideration of the problems of monotony, that an optimal condition exists somewhere between unvaried and frequently varied work. The loss of time from too frequent shifting must be avoided as well as the loss from weariness when no changes are permitted. The schedule of changes will vary with the type of work, such as the time required to complete one unit of work, whether the operators are slow or rapid, and the amount of concentration of attention needed. A detailed study of the form of the daily work curve will be necessary to plan the optimal schedule (Chapter 23).

11

The Influence of Drugs and Stimulants

Any discussion of the regulation of human behavior necessitates some reference to the mass of data and opinion upon the effects of drugs and stimulants. The great publicity given to the marketing of coffee substitutes with emphasis upon the harmful effects of coffee, the repeated attacks by the Federal Government upon certain soft drinks containing small amounts of drugs, the periodical threats against the sale and use of tobacco, the introduction of nation-wide prohibition and its subsequent repeal, the spectacular effects of drug addiction, and the growing alarm over the presumed relationship between alcohol intoxication and automobile accidents have given the question of the effects of these substances a prominent place in the minds of all people. Serious confusion has resulted from the dissemination of misleading statistical information, so that at present the people at large have no satisfactory basis for the formation of an opinion. Partisanship of one sort or another has always been back of the propaganda upon which such opinions rest. What is most needed today is an unbiased evaluation of the existing data relating to the effects of these different substances when taken in small or large quantities and over different lengths of time, and the prosecution of more elaborate and intensive investigations for the accumulation of further information.

SOURCES OF ERROR IN DRUG INVESTIGATIONS

The real effects of drugs and stimulants upon human activity must be determined from the most careful scientific procedure as opposed to the unchecked opinion and prejudice which are responsible for the common popular impressions. The problems to be met in this type of psychological research are many and difficult. The principal source of error comes from the suggestibility of people who have a knowledge of the effects to be expected. Much of the experimental work has failed to eliminate the possibility of suggestion and the results are questionable on that account. A further source of error in many tests has been

the lack of control subjects, or persons who are treated in every way identical with the others, except that the drug or stimulant in question is not administered to them. Control groups serve as a check against interpreting as drug effects results which follow from other factors, affecting both groups alike. The first difficulty, that of suggestibility, can be avoided only by preventing persons from knowing what drugs they are taking, and when they are taking them. The drugs must be disguised, usually by having them placed in a neutral substance of some kind, which may be given regularly, sometimes containing the drug and sometimes not. In some cases the fulfilment of these conditions is extremely difficult and in others practically impossible.

A further serious difficulty in this type of investigation, which, however, is not limited to drug experiments exclusively, concerns the measurement of the effect. Shall it be measured in terms of the condition of some bodily organ, in terms of behavior, or in terms of feelings—a purely subjective measure? Each kind of indicator, when taken alone, seems to be inadequate. For example, the effects of a drug are likely to consist in an increased difficulty of a given task, a greater inertia which must be overcome. But it can be overcome by increased effort, hence the objective measure may remain unchanged (Chapter 7). In such a case it might appear that the feelings of effort would be a more accurate measure than the objective record, except for the known unreliability of the subjective criteria of efficiency. A study by Hollingworth (*281*) demonstrates the variability of different indicators of drug effects. He measured the effects of alcohol when taken in small and large doses by means of the introspective reports of the persons taking it, the reports of observers, and the records of performance in a series of motor and mental tests. He concludes:

> It seems clear, then, that effects may be present which are measurable by properly chosen technique long before they are manifested in the individual's gross conduct in a normal, social, working situation, and even a considerable time before they are indicated by the subjectively reported symptoms.

In order that all measures shall agree, the doses of alcohol must be very large and be consumed within one hour. Most of the experiments upon which our discussions are based have used objective records of one kind or another to determine drug effects, emphasis being placed upon the selection of forms of behavior which are partially independent of voluntary control.

Another difficulty may be mentioned, namely, that the experiments devised for testing the effects of drugs and stimulants are of short duration in contrast to the long periods over which they may be used in actual practice. Consequently, conclusions from such experiments should be limited to the temporal circumstances under which the tests

were made and should not be extended to cover cases of long continued use. This error is not peculiar to psychological research. Indeed, the same criticism may be lodged against the tests of the physiological effects of benzoate of soda and other similar preservatives which establish them as harmless when taken in extremely small quantities Has the possibility of cumulative effect from long continued use been sufficiently taken into account? (*271*)

Finally, drug studies must reckon with the ever-present fact of inter-individual and intra-individual differences. The small groups of subjects used in laboratory experiments may not be representative of larger populations, and the times and conditions selected for the study of the individual may not be indicative of his behavior at other times and in other circumstances. Large test groups studied over long periods would seem to offer the only way of meeting these two sources of error.

Our discussion will deal mainly with the effects of the more common drugs and stimulants, such as are real factors in the problem of personal efficiency. They will be considered in the following four groups: (1) tobacco, especially when smoked; (2) alcohol, in the various forms in which it is commonly taken; (3) caffeine, which is the drug appearing in coffee, tea, and some soda-fountain drinks; and (4) benzedrine.

THE EFFECTS OF TOBACCO ON EFFICIENCY

The increasing use of tobacco by women and girls since the first World War might have been expected to increase the volume of research upon its effects, but such has not been the case. Very few studies have been published during these years. There is no way of knowing whether this lack of research interest is owing to disbelief in any harmful effects, to skepticism regarding the whole question, or to a disregard of consequences. Curiously enough, current advertising for cigarettes appears to assume the belief that there are harmful effects from smoking, since the sales appeal for a given brand is based on *its own less harmful effects*. Thus, one brand is "easier on the throat," another is "less irritating," another contains "less nicotine," another has "not a cough in a carload," while all emphasize the "mildness" of their particular product attained by their selection of the raw tobacco or their treatment of it in the process of manufacture. The implication in all these phrases is that smoking is harmful, but the harm can be reduced by using a particular brand.

From a scientific point of view the investigation of tobacco, and especially of smoking, is subject to all of the difficulties mentioned above as peculiar to drug problems. Particularly important and almost

impossible to eliminate is the factor of suggestion. And in all cases the experiments fall short of life conditions in that they cover relatively brief periods of time. Most of the experiments report the effects which follow immediately after smoking, the indulgence being limited usually to one cigar or cigarette.

Much of the evidence concerning the effects of tobacco which attracts popular attention is anecdotal in character. The man who attains the ripe age of ninety years and who smoked all his life is a familiar case. Such instances can be matched with those who reach the same age and attribute their longevity to abstention from the use of tobacco. Material of this sort confuses the issue and engenders prejudice and controversy.

Little better than the anecdotal sort of evidence is the statistical compilation of the number of inmates of penal institutions and insane asylums who use tobacco, or the statistical analysis of populations into tall and short together with the determination of how many in each group smoked or did not smoke during the growth period. Correlations between school grades and smoking habits have frequently been reported, showing in most instances the deleterious effects of the use of tobacco.

Another type of evidence has come from the studies of nicotine. Tobacco is popularly believed to reduce efficiency by introducing this substance into the body. Consequently, nicotine has been given in experimental doses and the effects produced are interpreted as indicative of the effects of tobacco smoking. The proportion of nicotine carried in smoke ranges, according to different authorities, from 7 to 70 per cent of that contained in the tobacco. As a matter of fact, chemical analyses led Bush (*76*) to conclude that it is exceptional to find any nicotine at all in tobacco smoke. (It does occur in small quantities in the smoke of rapidly burning cigarettes.) The nicotine in the burning is decomposed into pyradine and other substances. It may seem to make little difference whether the toxic factor be called nicotine or pyradine, except for the fact that pyradine is only about one-twentieth as poisonous as nicotine. The physiological effects of nicotine introduced into the body through smoking are said to be moderate constriction of blood vessels, rise in blood pressure during the smoking period with a rapid fall immediately afterward, primary slowing of the heart action followed by a secondary quickening and increase in the rate and amplitude of breathing.

PHYSICAL EFFECTS OF TOBACCO

Most of the experiments concerning the influence of tobacco upon physical efficiency have been made with the ergograph, measuring the

physical endurance of a limited number of muscles, in terms of amount of work done in a series of muscular contractions; or by the dynamometer, measuring the strength or force of single muscular contractions. Rivers (*519*) reports Lombard as having found that a single cigar of moderate strength reduced muscular strength from 10 4 to 2.1 kilogrammeters,* or a decrease in efficiency of 80 per cent. This depression began to disappear soon after smoking ceased, but complete recovery required more than one hour. The same investigator found that muscular contractions produced by electrical stimulation, rather than by the individual's volition, were not reduced, and consequently located the depressing effect somewhere in the central nervous system. He also cites Feré to the effect that cigarette smoking was found to induce a state of depression, after an interval of fifteen minutes, showing itself in reduced capacity for work. Other investigators have not found such striking results. Rivers (*519*) reports a change after smoking no greater than that which occurs normally at different periods of a day. His explanation of the slight decrease in efficiency found in his own test is interesting. The by-products of the act of smoking such as the taste and smell of tobacco are likely to be stimulating, and are in themselves causes of increased efficiency. The small decrease in efficiency which results from smoking is significant when compared with the expected increase from this sensory stimulation. Rivers' interpretation illustrates the complicated character of the whole experimental problem, and of the necessity for the most careful interpretation of data. The prohibition of smoking in all persons who are undergoing training for speed, strength, and endurance tests is a practical application of the belief in the deleterious effects of tobacco on physical efficiency.

MENTAL EFFECTS OF TOBACCO

The influence of tobacco on mental efficiency has been the subject of few important researches, and none has succeeded in eliminating all sources of error. It is in this type of work that suggestion plays its largest rôle and where the necessity for control subjects is greatest. Furthermore, the mental tests of efficiency are almost all subject to improvement from practice and often a great improvement may be noted from one repetition of the test to another. In the absence of controls, improvement from practice might be wrongly attributed to the stimulating influence of tobacco, or might hide a real decrease in mental efficiency.

The most thoroughly controlled investigation of the effects of to-

* A unit of measure meaning the work done in lifting a weight of one kilogram to the height of one meter.

FIGURE 56

SHOWING THE USE OF THE CONTROL PIPE *

* From C L Hull, The Influence of Tobacco Smoking on Mental and Motor Efficiency,' *Psychol Monog*, 1924, 33 No 150 (Frontispiece)

bacco smoking is that of Hull (*300*), carried out with the support of the American Committee for the Study of the Tobacco Problem. He used all the controls that have been found essential in other drug studies and succeeded by an ingenious technique in preventing the subjects from knowing whether or not they were really smoking.

This was accomplished in part by having his subjects blindfolded during their smoking, and by providing an electrically heated pipe through which the smoker drew warm and slightly moist air. Figure 56 shows this device being placed in a subject's mouth. Elaborate preliminary preparations and explanations were intended to forestall any suspicion of the presence of the control.

The scope of his investigation, which suggests the limitations of his conclusions, is stated as follows:

> To determine quantitatively the effect upon the efficiency of a dozen typical mental and neuro-muscular functions of young men, of smoking a large pipe of mild tobacco for a period of 25 minutes, the smoking to take place 1½ hours after a meal, the smoke to be blown from the mouth at once and not inhaled, and the effects to be traced for a maximum of 1 hour and 45 minutes after the smoking ceased.

His results are summarized in Table 26. The figures are in terms of percentage, stimulation or improvement in efficiency being indicated by a plus sign and depression or loss by a minus sign. The figures having "a satisfactory statistical reliability" are marked with a ‡. A † means that the figures are probably reliable. The numbers, 1,2,3 indicate the first, second, and third test after smoking. Hull's conclusions may be stated in his own words (*300,* 145):

> ... Only three of the 12 forms of behavior investigated reveal an unmistakable influence of smoking. Two of these (pulse and tremor) are essentially physiological. The interest of the present investigation, on the other hand, is primarily in the more strictly psychological processes. Of these, only one (Addition) shows an unmistakable effect. Several others show effects with a fair degree of reliability, however, and are entitled to consideration Probably the two most significant tests of this intellectual group as revealing the influence of smoking on mental efficiency, are Complex Mental Addition and Rote Learning. The first, together with Reaction Time, may be presumed to give some indication of the effects of smoking upon ordinary routine thinking, which is essentially the functioning of old associative bonds. The evidence in this case is favorable to tobacco where the subject is accustomed to its use On the other hand, Rote Learning, possibly supported by Memory Span, presumably indicates the effect that tobacco is likely to have where new associative bonds are in the process of formation, as in most school learning. The results in this case, while not so reliable, are unfavorable to tobacco. It must be remembered, of course, that the above formulations apply with strictness only to the first hour and a half after the termination of smoking. Generalizations from them must be made with extreme caution.

TABLE 26

Effect of Smoking on Efficiency *

		Non-Smokers			Habitual Smokers		
		Test number			Test number		
		1	2	3	1	2	3
Neuro-muscular processes	Pulse rate	+ 12 63 ‡	+ 3 07 ‡	+ 2 74 ‡	+ 8 09 ‡	+ 7 25 ‡	+ 4 52 ‡
	Tremor of hand	— 29 80 ‡	— 31 20 ‡	— 23 20 ‡	— 38 30 ‡	— 22 30 ‡	— 4.80 †
	Tapping	+ 1 35	— 1 14	— 0 39	— 1 40	— 0 90	+ 0.50
	Muscular fatigue	+ 32 20 ‡	+ 10 10 †	+ 6 20 †	+ 9 60 †	+ 3 70	— 12.50
Sensory-motor processes	A-test, speed	— ?	— ?	— ?	+ 0 10	— 1 20	— 1 40
	A-test, accuracy	— ?	— ?	— ?	+ 22 20	+ 32 10 †	+ 38 80 †
	Reading, reaction time	+ 1.08 †	+ 0.05 †	+ 0 54 †	+ 1.20 †	+ 0 05 †	+ 0 85 †
	Learning, reaction time	+ 4 41 †	+ 0 44 †	+ 3 65 †	+ 0 70 †	+ 0 35 †	+ 5 55 †
Higher mental processes	Adding, speed	— 2 94 ‡	— 3.43 ‡	— 2.96 ‡	+ 3 00 ‡	+ 4 58 ‡	+ 6 55 ‡
	Adding, accuracy	— 26.50	— 36 00	— 17 50	— 2 40	— 3 40	+ 1 20
	Memory span	— 6 38 ‡	— 2.53 †	— 6 46 ‡	— 5 22 †	— 1 83 †	— 3.95 †
	Rote learning	— 8 02 ‡	+ 4.33	+ 3.61	— 10 10	+ 0 20	— 6 20

* From C L. Hull, "The Influence of Tobacco Smoking on Mental and Motor Efficiency," *Psychol. Monog*, 1924, 33, 3, 142.

A safe conclusion from these experiments would seem to be that the more adequate the controls and the more careful the experimentation the smaller seems to be the effect of tobacco smoking. Although no serious decrease in efficiency is recorded over the period covered by these tests, neither is there enough evidence for an increase in efficiency sufficient to justify smoking for that purpose. Although smoking may be justified as a means of bodily comfort and enjoyment, one might well question what advantage it has over the other forms of recreation except where the habit has already been firmly established.

THE EFFECTS OF ALCOHOL ON EFFICIENCY

The effect of alcohol upon the human body has been the subject of controversy for at least a century. Jellinek and Jolliffe (*318*) have estimated that during that period "a jungle of 96,000,000 words has grown around the problem." Publication during recent years has been increasing at an accelerating rate. These authors have found 266 books and articles that have appeared during 1939 alone on the effects of alcohol *upon the individual.* The whole resembles a jungle, indeed. There are many reasons for the present state of confusion. Foremost among these is the injection of emotion into thinking about the subject, particularly because of its moral and religious implications. Added to this are the striking individual differences in the reaction to alcohol, with the result that the choice of persons for study may predetermine the results. Partly responsible also is the fact that when taken in small quantities alcohol may act as a food, whereas in larger quantities it may become a poison. And, finally, while it stimulates one set of organs it depresses the action of others. Over and above these factors leading to confusion are the sources of error common to all drug experiments and listed at the beginning of this chapter. Especially important is the influence of expectation and suggestion. Most persons have well-established notions concerning the effects of alcoholic drinks, and even the investigators themselves have been known to be influenced by their preconceptions either as defenders or opponents of the use of alcohol. In order to avoid the influence of expectation it is necessary to disguise the presence of alcohol. This is extremely difficult to do. The attempts to do so vary all the way from intravenous injections (*466*) to the drinking of alcohol in a mixture of lemon juice, orange juice, carbonated water, bitters, tabasco sauce, and powdered sugar (*542*). In every instance it is possible to detect the presence of alcohol, from the "glow" which it creates, if in no other way.

An attempt to bring order into the whole subject of alcohol research

was started by the establishment in 1938 of the Research Council on Problems of Alcohol (*435*) as an adjunct of the American Association for the Advancement of Science, whose main and primary purpose is to ascertain the facts and then to make these facts available to the public. An important medium for the dissemination of the information has been provided in the *Quarterly Journal on Studies of Alcohol* which is associated with the Council.

Excellent surveys of the literature on the effect of alcohol upon bodily structure and function (*318*) and upon psychological functions (*319*) (*396*) are now available One of the latter by Jellinek and McFarland is particularly valuable for its critical inspection of the psychological techniques that have been employed and of the data that have been derived therefrom. Only that material will be discussed in this chapter which bears directly upon efficiency in everyday life.

PHYSIOLOGICAL EFFECTS OF ALCOHOL

Although the bulk of the immense literature upon the physiological effects of alcohol (*261*) (*318*) need not concern the applied psychologist, certain aspects of it are extremely important. These have to do with the absorption of alcohol by different body tissues, the latent time and the rate of such absorption, and the factors which influence them, as well as the process of elimination, its latent time and rate, and the factors which influence these. Definite data on these matters will form the basis for correlations between the physiological functions and the psychological reaction. Correlations of this sort are seriously needed since certain physiological measures such as amount of alcohol in the expired air, in the blood, and in the urine are being sought and adopted as simple and practical measures of intoxication.

It is now known that the physiological effect of a given amount of alcohol will vary roughly with the body weight, the greater the weight the less the effect. This is because of the fact that all the tissues absorb the substance sufficiently uniformly that the greater the body bulk the less alcohol each tissue will receive. Account must be taken, however, of the rate at which the alcohol is absorbed from the stomach and intestinal tract, for the rate of elimination is such that if the rate of absorption is sufficiently slow, elimination may overlap absorption and the maximal effect be thereby reduced. Many factors influence rate of absorption. It is most rapid when the stomach is otherwise empty. Various foods have a differential effect upon rate of absorption. The greatest deterrents are fats, particularly in the form of milk, cream, and butter. Another factor determining rate of absorption is the concentration of the alcohol. Although there is some disagreement

about the matter, it may be said that the greater the concentration the more rapid the absorption. Therefore, the rate of absorption of a light beer and its consequent maximal effect will be less than that of a high proof whiskey. There are many other factors influencing rate of absorption, among them degree of habituation to alcohol; but space will not permit the discussion of them. The generalization may be made that under ordinary circumstances the maximal concentration in the tissues will occur in a half hour to two hours after drinking, and that in two and a half hours the intestinal tract will be free from alcohol.

Reduction of the amount of alcohol in the tissues depends upon a variety of factors also. After a given amount has been absorbed, the process of reduction will occur by way of oxidation and by way of elimination through the kidneys and bladder, the skin and the lungs. Each one of these avenues of reduction is open to its own set of influences. Thus, elimination by way of expired air depends among other things upon rate and depth of respiration; elimination by way of the urine depends in part upon factors which influence frequency of urination; and oxidation depends among other things upon degree of habituation. With this variety of influences at work, it is not safe to offer any generalization concerning the rate at which alcohol will disappear from the body.

The statement was made above that different body tissues tend to absorb alcohol uniformly. It should be emphasized that there is only a tendency toward uniformity in this respect. One cannot rest so heavily upon the expectation of uniform distribution as to accept the amount present in one tissue as a measure of that in another tissue. For instance, the correlation between the amount of alcohol in urine, blood, and brain tissue is not 1.0. Just how high the positive correlation is, and whether it is high enough to justify a prediction concerning the brain from the condition of one of the other tissues, is a matter of dispute. One can readily understand the significance of this whole question for psychological interpretation.

INFLUENCE OF ALCOHOL UPON MOTOR FUNCTIONS

Everyday acquaintance with users of alcohol would lead one to expect laboratory and field studies to show a marked effect upon motor control. The uncertain gait, the thick speech, the double vision, and the poor eye-hand coördination leading to awkward reactions are the generally accepted symptoms of too much alcohol. Research attention was early directed to the quantitative determination of such changes (*430*). Rivers (*519*) was the first investigator to disguise the alcohol in a mixture so that it could not be detected by the person taking it,

and thus largely eliminated the influence of suggestion. He found practically no effect upon muscular work from taking alcohol in doses ranging in size from five to ten cubic centimeters. Effects previously found by others from such small doses he attributed to the sensory stimulation and the expectation of stimulating effects. Even doses as large as 40 cubic centimeters did not produce entirely consistent results in all cases. Sometimes there would be an increase and sometimes a decrease in total work done. Whenever an effect was noted, however, it consisted in a change in endurance or duration of the work rather than in the quantity of work done per unit of time.

Dodge and Benedict (*141*), working in the Nutrition Laboratory of the Carnegie Institution, found that instead of alcohol's being a general stimulant as is commonly supposed, it is really a depressant. Only in the case of the pulse rate did they find an acceleration; but even this was not an absolute increase in rate as it represented only the absence of the gradual decrease in pulse rate in the course of moderate mental and physical work. In the case of simple reflex and sensory processes, the depression expressed in percentages is as shown in Table 27.

TABLE 27

INFLUENCE OF ALCOHOL ON SIMPLE MOTOR REACTIONS *

	Per Cent
Latent time of the knee jerk increased	10
Thickening of the quadriceps muscle decreased	46
Protective eyelid reflex, latent time increased	7
Extent of eyelid movement decreased	19
Eye reactions, latent time increased	5
Speed of eye movements decreased	11
Sensitivity to electric stimulation decreased	14
Speed of finger movements (tapping) decreased	9

* Adapted from R. Dodge and F. G. Benedict, "Psychological Effects of Alcohol," *Carnegie Instit. Wash. Publ*, 1915, No. 232, 244

A bit of apparently conflicting evidence of some interest comes out of the work of Travis and Dorsey (*650*). Using a dose which varied for each subject but in each case so heavy as to make the subjects partially unconscious, they found an increase in reflex speed, that is, a reduction in the latent time. The discrepancy between this and other research is explained away by the authors on the reaction level theory. That is to the effect that alcohol works progressively from the highest centers downward and that the extremely large dose depressed the inhibitory control of the higher centers upon the reflex to such a degree as to overshadow the direct depressing effect upon the reflex mechanism itself.

An extensive study of the influence of alcohol upon psychological processes has been made by Hollingworth (*270*). Among other functions, he tested steadiness of the hand, rate of tapping, and coördina-

tion of hand and eye. The alcohol was administered in the form of beer, and for control purposes the same kind of beer was employed except that the alcohol had been extracted from it. The test schedule was so arranged that the effect of the alcohol could be measured against performance earlier in the day before the alcohol was taken, against days when only the control dose was taken, and against days when neither alcohol nor the control was taken (blank days). The data for all the tests are given in condensed form in Table 28. In all cases the figures are in terms of percentage of forenoon records, *plus* meaning improvement and *minus* meaning impairment of efficiency. The last three columns in the table show the effects of drinking from three to nine bottles of beer. The data indicate that in every motor function there was a decrease in efficiency, the hand being less steady, motor coordination slower and less accurate, and the speed of tapping reduced.

TABLE 28

INFLUENCE OF ALCOHOL ON MENTAL AND MOTOR EFFICIENCY *

	Blank	*Control*	*Bottles*		
			3—4	5—6	6—9
Pulse	− 7	0	+ 8	+ 10	+ 19
Steadiness	+ 11	− 21	− 68	− 241	− 370
Tapping	− 2	0	− 7	− 13	− 14
Coordination	+ 3	− 2	− 6	− 10	− 20
Color naming	− 6	− 3	− 2	− 7	− 12
Opposites	− 2	− 7	− 5	− 12	− 23
Adding	− 4	0	− 5	− 10	− 15
Substitution	− 1	− 5	− 4	− 9	− 6
Memory	...	...	− 21	...	− 60

* Adapted from H L Hollingworth, "The Influence of Alcohol," *J of Abn (Soc) Psychol.*, 1923-24, *18*, 317

Such functions as marksmanship and typewriting which require a high degree of eye-hand coördination should be expected to show depreciation from the use of alcohol in the light of the data of Table 28. Miles (*430*, 235), in reviewing the researches on marksmanship, comments upon the relatively slight deterioration in accuracy, one study showing a maximal loss of only 2.5 per cent. His interpretation conforms to that offered for resistance to distractions in Chapter 7 when he says:

It must be remembered that shooting does not make a continuous and strenuous demand on the person who is engaged in it, therefore, strongly motivated, well-trained marksmen can often approach their normal scores even though they are old, fatigued, hungry, ill, or otherwise handicapped. They can pull themselves together for a moment, make a shot, and then relax before another

effort has to be made Because momentary self-control can be practiced with fair success after drinking alcohol, sharp shooting and reaction time with certain stimuli often show relatively slight interference after small amounts of the narcotic.

The above observations are supported by the fact that typing, which demands continued control, shows a marked decrease in efficiency. Both Vernon (*661*) and Miles (*430*, 236) found decreases in accuracy of very considerable amounts from moderate doses of alcohol, even when taken with food. When taken into an empty stomach the errors increased from 40 to 100 per cent above the normal. Speed, though not so seriously affected, did show a slight loss.

The color-naming test used by Hollingworth is a sensitive measure of control of the highly complex motor mechanism of speech. Table 28 shows a loss in this function which increases with the size of the dose. These few samples of the researches on motor control show a measurable loss of efficiency except where the adjustments that are required are of momentary duration.

INFLUENCE OF ALCOHOL ON THE SIMPLER MENTAL FUNCTIONS

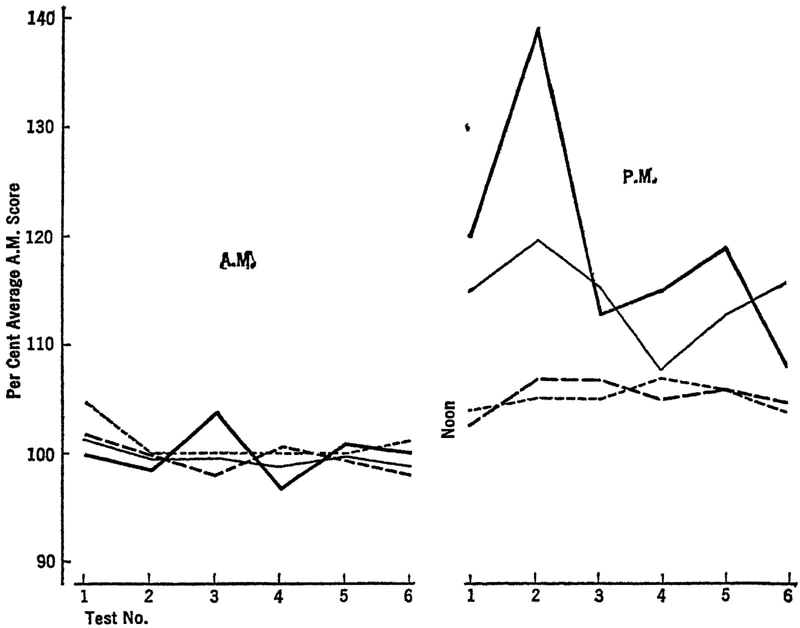
Concerning the influence of alcohol on mental efficiency, popular opinion must be clearly distinguished from the results of scientific experiment. Alcohol in small doses is commonly supposed to increase mental activity, and to produce a feeling of general well-being, effects which quickly disappear when larger doses are taken. Under careful experimental conditions, Dodge and Benedict found that memory and association were only slightly affected and in the general direction of a decrease in efficiency. Thus these simple mental processes would resemble the reflexes and the motor mechanisms in their reaction to alcohol. Hollingworth (*270*), in the research mentioned above, tested such mental processes as naming of opposites, adding figures, substitution of symbols according to a simple code, and memory. The data in very condensed form and for all his subjects are given in Table 28. As previously described, the figures express the percentage of change over the morning tests before any alcohol was taken. As minus signs mean decreased efficiency, it appears that every one of these functions was adversely affected. A more detailed sample of Hollingworth's data is given in Figure 57 for the addition test.

The points on the base line of the figure indicate the different test periods during the day; the break in the line shows the intervening lunch period when the drink was administered. There were six tests before and six after the dose. The vertical scale is in terms of per-

centages of the average morning score, which is taken as 100. Each point on the scale is the average of the records of six subjects on two different days, or twelve records in all. The solid line represents large alcohol days (five to six bottles), the fine line the small alcohol days (three to four bottles), the broken line the control days (beer without alcohol), and the dotted line the blank days (no beer at all). The six morning records are free from alcohol effect regardless of the type of

FIGURE 57

THE MENTAL EFFECTS OF ALCOHOL UPON ADDING*



* From H. L. Hollingworth, "The Influence of Alcohol," *J. Abnorm. (Soc) Psychol*, 1923-24, *18*, 234.

day, because the dose was taken at noon. As the records are in terms of time required to perform a given task, higher scores mean poorer records. Any differences in the morning records are the result of accidental variations or practice. It will be seen that all afternoon records are poorer than morning records, regardless of whether alcohol was taken or not. This is merely a case of the daily work curve which was described in Chapter 6. The blank days and the control days are practically the same, as would be expected, since there was no alcohol in either case. The large dose shows a considerable impairment at the first test period, increasing in the second and then decreasing through the remaining tests. The small dose shows the same characteristics but

less exaggerated. In the case of addition, the curves return almost but not quite to the point reached by the blank and control curves at the end of the final test period. The records for all the other tests present the same general characteristics.

After taking note of all the various factors that can influence performances under alcohol—such as individual differences, the taking of food, and tendency to compensate which have been mentioned by other investigators—Hollingworth concludes as follows (*270*, 237):

> In all of the mental and motor tests here used the effect of alcohol is to reduce the score. The hand is made less steady, motor coördinations less accurate and rapid, rate of tapping is reduced, the processes of color naming, naming opposites, and adding are slowed down, and the rate of substitution learning is less rapid. In pulse rate, which must be considered separately from these mental and motor tests, the effect of alcohol is to produce a positive acceleration.
>
> In all cases the effect varies directly with the size of the dose. In the association processes the effect of the smaller doses here employed has disappeared by the end of the experimental day, three hours after the conclusion of the drinking period. In the case of the motor processes (tapping, steadiness, and coördination) and pulse rate, recovery is slower, and even in the case of the smaller doses there is usually inferior performance or change of rate at the end of the day.

INFLUENCE OF ALCOHOL UPON HIGHER MENTAL PROCESSES

The term higher mental processes is here used rather loosely to include intelligent reactions, judgment, and reasoning. Special reference is made to them because of the important part they are believed to play in the causation of highway accidents. When one is driving a car at 50 miles an hour, a slight misjudgment of space available for passing, or of the time required to reach a given point on the road, or a slight decrease in the amount of "road courtesy" may spell the difference between safety and disaster. Changes in control such as these are difficult to measure in the laboratory, even though under equivalent conditions on the road the deficit might be observable. The degree of vigilance or alertness seems to be greater under laboratory conditions. On the road the monotony of sound and sight may make for relaxation of higher controls. These are obviously speculations which will be difficult to check, but which can be tested with the exercise of some ingenuity.

Certain laboratory studies have shown a loss of efficiency in the higher mental processes. Mead (*421*) compared the effects of 30 cubic centimeters of alcohol disguised in a mixture of grape juice, peppermint, and water upon simple conditioning and upon a symbolic mental

process consisting of the learning of an artificial language. His conclusion from the data of six subjects was that the conditioning was no more affected by the alcohol than by the control dose, both of these having given a slightly better performance. Suggestion was, doubtless, the potent factor. In the case of the artificial language the improvement was greater following the control than the alcohol in every case but one. The higher function, therefore, was considered to be more susceptible to deterioration from alcohol than the simpler form of learning.

Cattell (*100*) tested fifty subjects for possible effects of 12.5 cubic centimeters and 25 cubic centimeters of alcohol upon intelligence as measured by intelligence tests and upon recall. He found that 25 cubic centimeters, when checked against a control drink, "lowers the intelligence quotient and diminishes the power of recalling past experience." The loss in intelligence was 1 per cent. The effects of the smaller dose were clouded by individual differences, but Cattell feels that there is evidence for improvement of intelligence and recall following a dose of 12.5 cubic centimeters.

Seward and Seward (*551*) measured the effect of large doses of alcohol upon the accuracy and speed of syllogistic reasoning as a sample of the process of judgment. The syllogisms had been previously graded in difficulty. Twelve subjects in the main experiment were given from 50 to 70 cubic centimeters of alcohol in thymol, according to their weight. In addition to the judgment measurements, the time required to read the propositions and the time required to learn them both with and without alcohol were recorded. There was an expectation on the part of the experimenters that alcohol would delay the judgment processes and that the delay would increase with the difficulty of the syllogisms. Their data forced the conclusion that the judgment process as investigated by them was not affected by alcohol. However, reading time was lengthened in more than half of the cases and the recall of the propositions showed signs of impairment especially with the most difficult syllogisms. The influence of possible compensating mechanisms and of uncontrolled variables was invoked to explain the results. It should be noted that the subjects were cautioned to be deliberate in their decisions and to avoid "snap judgments." It is just possible, however, that the snap judgment or the emergency judgment is the type that would be most readily affected.

Practical conclusions are not difficult to draw in the case of alcohol and efficiency. Alcohol may possibly be taken in small quantities with benefit by the aged and certain types of invalids, where it may serve as a food. But over against this is the evidence that it is not a stimulant to increased efficiency for normals, but rather a depressant. Every func-

tion that has been measured in the laboratory, from the simple reflexes to the processes of judgment, shows this depression if there is any reliable trend at all. Furthermore, there is no doubt of the ill effects of the excessive use of alcohol. Large industries and railroads where safety is a public obligation have long made abstinence a necessary qualification for employment. The drastic regulations of many states concerning automobile driving while intoxicated place a heavy responsibility upon any one who drives after using alcohol.

WHEN IS A MAN INTOXICATED?

The foregoing statements raise an interesting and important question, When is one intoxicated? And they suggest the serious need for some kind of index which may be easily and quickly applied in everyday life. Hollingworth (*281*) raised the above question in 1925, and suggested three kinds of evidence which could serve as criteria of intoxication. They are: subjective or introspective report of the feelings, sensations, impulses, inclinations, and other experiences; overt behavior such as appearance, gait, gesture, and facial expression, and motor control which may be observed by another person; and technical measurements under controlled conditions of change in capacity or variability in performance of standardized tasks. There should be added to this list the various physiological measurements of the alcohol content of the expired air, of the urine, of the blood, of nerve tissue, and, as a final possible measure, the kind and amount of alcoholic drink consumed.

Hollingworth obtained data on the first three of these measures from his experiment described on page 210. From Table 28 it appears that even the smallest doses affected all the functions tested, and evidence not included there showed that even smaller doses than these affected adversely the processes of adding, substitution, opposites, and paired associates. His subjective evidence came from written introspective reports that were subsequently rated by five judges as being given on either normal, control, or alcohol days. His behavior evidence was derived from the observation of the subject's behavior by three judges. Table 29 gives the data for the subjective and behavior evidence for the normal, control, small alcohol, and large alcohol doses. The table should be read as follows: normal day records, when no drink was taken, produced introspective reports that were judged to come from alcohol days in 13 per cent of the cases, from control days (when beer with alcohol removed was drunk) in 3 per cent of the cases, and from normal days in 84 per cent of the cases. Normal day records produced behavior reports that were judged to come from alcohol days in 7 per

cent of the cases, from control days in no case, and from normal days in 93 per cent of the cases.

Inspection of the data shows that introspective reports revealed evidence of alcohol in the two small doses in 55 per cent of the cases whereas behavior reports did the same in only 28 per cent of the cases. The larger doses revealed themselves about equally in introspection and behavior. The experiment as a whole is interpreted by Hollingworth

TABLE 29

MEASURES OF INTOXICATION *

Dosage	*Percentages Based on Introspective Reports*			*Percentages Based on Behavior Reports*		
	Alcohol	Control	Normal	Alcohol	Control	Normal
Normal record, two days	13	3	84	7	0	93
Control record, two days	10	57	33	5	10	85
Alcohol doses, small						
39 cc.	60	30	10	23	10	67
52 cc.	50	23	27	33	47	20
Average	55	27	18	28	28	44
Alcohol doses, large:						
65 cc.	83	7	10	77	13	10
78 cc.	70	10	20	73	17	10
Average	77	8	15	75	15	10

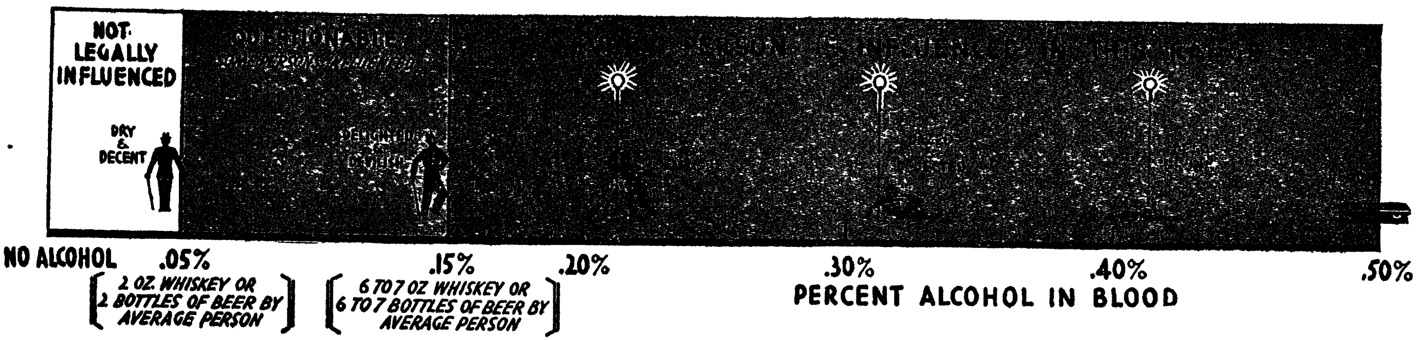
* From H L. Hollingworth, "When Is a Man Intoxicated?" *J of Appl. Psychol*, 1925, *9*, 126.

to mean that tests will detect the effects of alcohol that neither introspection nor observation of behavior will reveal, and that introspection is more sensitive than behavior as an indicator.

What is lacking but is very badly needed are exact studies of the relationship between physiological indicators such as alcohol in the urine and blood and behavior manifestations and test records. It is obvious that only slight relation can be expected between the amount ingested and the psychological manifestations since there is not a one to one relation between amount ingested and amount absorbed. Just what the relation will be between amount absorbed and accurately measured psychological reactions is not clear at present, but it is known that people differ in their tolerance of alcohol ingested and alcohol in the blood. In the report to be referred to below, the generalization is

FIGURE 58

Relation Between Alcohol in the Blood and Degree of Intoxication *



* From *Report to Street and Highway Traffic Section*, National Safety Council, Chicago, Ill , 1940.

made that, regardless of tolerance, the extent of alcohol influence parallels the concentration of alcohol in the blood within the limits of biological variation estimated to be about plus or minus 10 to 15 per cent. Percentage of alcohol in the blood has come to be a well-accepted test of intoxication. According to the report of the Committee on Tests for Intoxication (*110*) of the National Safety Council, twenty-seven states used chemical tests for the purpose in 1939. The publicity illustration in Figure 58 indicates the relation presumed to exist between percentage of alcohol in the blood and the subjective-behavior reactions. It is obvious from the descriptive terms used that these correlations are not the product of laboratory tests.

THE EFFECTS OF CAFFEINE-CONTAINING SUBSTANCES

Caffeine, as the active principle of beverages such as coffee, tea, and certain soda fountain drinks, has been the subject of many investigations. Since it is so commonly used by persons who shun any other stimulating drinks, it is important that its real effect should be known. The popular impression is that it acts as a stimulus to both muscular and mental work, especially the latter. There is much evidence that coffee and tea and other substances containing caffeine should be called habit-forming drinks. The person who cannot be deprived of his strong coffee or tea without getting a headache, or at least being incapacitated for work, is a common spectacle. And an equally familiar case is that of the person who is kept awake all night by an after-dinner cup of coffee, or the student who drinks a cup of coffee to enable him to continue his studies beyond the hours when he usually retires. Are these popular notions supported by the results of experimental work?

EFFECTS OF CAFFEINE UPON MOTOR PROCESSES

As in the case of other drugs studied, most of the early work produced conflicting and inconclusive results mainly because of the lack of adequate controls. The preponderance of evidence, however, pointed toward a stimulating effect of moderate doses of caffeine upon muscular work done on the ergograph and the dynamometer. Rivers (*519*) confirmed these findings although his experiments designed to exclude all mental factors such as suggestion and interest show a much smaller increase than the earlier experiments. He found large individual differences in susceptibility to the drug, and in the duration of the effect. The tests of speed of movement, motor coördination, and steadiness made by Hollingworth (*271*) on sixteen subjects over a period of forty

days, in which every known precaution against errors was taken, show interesting physical effects of caffeine. It produced an increase in the speed of movement, the amount, which depends on the size of the dose, being about 4 per cent in a group of twelve persons. The doses ranged from 2 to 6 grains, the equivalent of which in terms of coffee and tea may be seen from the figures in Table 30.

TABLE 30

CAFFEINE CONTENT OF COFFEE AND TEA

	Grains of Caffeine
Average cup of hot black tea contains	1.5
Average after-dinner cup of black coffee contains	1.5
Average glass of cold green tea contains	2.0
Average cup of coffee with milk contains	2.5

The Steadiness Test, designed to give an indication of general nervousness, showed that doses of 1 to 4 grains produced slight nervousness, appearing several hours after the drug was taken. Larger doses of 6 grains produced greater nervousness, appearing sooner and increasing during a period of several hours. Hull (*299*), who administered 5 grain doses of caffeine which were comparable with Hollingworth's larger dose, found an increase in hand tremor of 11 per cent.

The Motor Coördination Test, as used by Hollingworth, combining speed and accuracy of movement, shows an effect which appears to be a compromise between increased speed and decreased accuracy of control. The results of Hollingworth are still further confirmed by Thornton, Holck, and Smith (*636*) who found improvement from caffeine in handgrip and tapping, and a decrease in steadiness. Small doses produce stimulation, whereas larger doses, 4 to 6 grains, cause a retardation or decrease in efficiency following a brief initial stimulation. The greatest retardation noted for five persons averaged only 2.7 per cent. Individual differences were prominent, with clear evidence that the magnitude of the effect varies inversely with the body weight of the person.

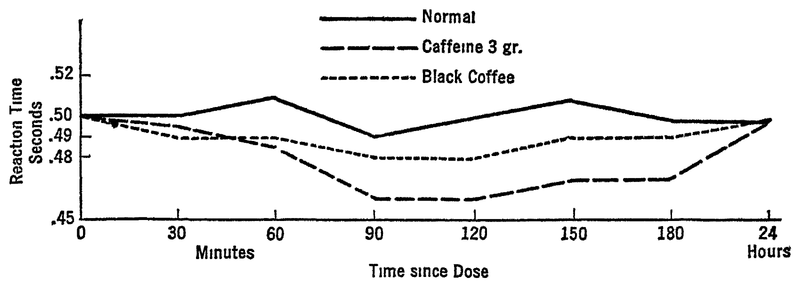
MENTAL EFFECTS OF CAFFEINE

Among the mental functions that have been tested for the effects of caffeine, reaction time probably resembles most closely the motor functions discussed above. Hollingworth (*271*) included choice reactions to color in his battery of tests and found a rather curious difference in response according to the size of the dose. Small doses (about two grains) produced a retardation with increase in the number of errors, and larger doses (4 to 6 grains) caused facilitation, showing within two hours and lasting until the following day. Cheney (*104*)

measured the choice-reaction time of five girls after taking water, black coffee (3 grains of caffeine), caffeine capsules (3 grains), and starch capsules (control). Tests were made from forty-five minutes to twenty-four hours after the administration of the dose. His results for the average of all subjects are shown graphically in Figure 59. The vertical scale indicates reaction time in hundredths of a second and the hori-

FIGURE 59

THE EFFECT OF CAFFEINE UPON REACTION TIME*



* From R H Cheney, "Reaction Time Behavior after Caffeine and Coffee Consumption," *J. Exp. Psychol*, 1936, *19*, 363

zontal scale shows the interval after the caffeine was taken. The solid line is the normal following water, the dotted line is the black coffee record, and the broken line is the caffeine capsule record. It will be seen that at every interval the caffeine, whether taken in coffee or in capsule form, caused increased speed of reaction, until at the end of twenty-four hours the subject had returned to the normal speed. Coffee increased the speed on the average 4 per cent and the caffeine capsules 8 per cent. These results support rather than conflict with those of Hollingworth, since Cheney's dose falls midway between the former's small and large doses.

Typewriting, which involves choice reactions with highly coördinated movements, was found by Hollingworth (*271*) to be quickened by small doses and retarded by larger doses. Where there is an increase in speed it is not gained in any case at the expense of quality. In fact quality of performance seemed to be improved by doses of every size. In this complicated function there is probably the interaction of two influences, that upon coördination tending toward retardation and that upon speed of reaction tending toward facilitation, the larger doses affecting the former more than the latter. Hollingworth found (*271*) that the processes of association involved in the naming of colors, naming opposites to each of a series of words, and adding digits all showed improved performance from every size of dose. The effect which was very slight

in some cases reached a maximum of 15 per cent in the naming of opposites. The stimulation lasted for three to seven hours and was followed by no measurable retardation.

Hull (*299*) made some measurements of the effects of caffeine (5-grain capsules of caffeine citrate) upon the learning of nonsense syllables. He found an average retardation of 2 to 3 per cent following caffeine when checked against a control capsule containing lactose. It should be noted that his dose was rather large and that the average decrement was not statistically reliable.

Gilliland and Nelson (*212*) agree with earlier investigators that caffeine is selective in its influence, but they disagree concerning the direction of the change produced. They find a decrease in steadiness and increase in rate of adding figures, as others have found, but their subjects who drank one and two cups of coffee showed very slightly decreased reaction time, from .5 to 1 per cent in amount (simple auditory reaction time), and decreased rate of tapping. Memory span was slightly increased.

EFFECTS OF CAFFEINE UPON HIGHER MENTAL PROCESSES

Evidence concerning the effects of caffeine upon "higher mental processes" is scanty. Cattell (*100*), whose work on alcohol was cited on page 215, also administered doses of 3 and 6 grains of caffeine under the same experimental conditions as those described for alcohol, and measured their effects upon intelligence and recall. He found the larger dose "detrimental to intelligent or associative performance, but particularly to the latter." The smaller dose gave a slight indication of lowering the intelligence and of improving the memory somewhat. If solving chess problems qualifies as "higher," then the interesting study of Holck (*265*) may be cited. He ran a long series of experiments upon himself, in which he solved chess problems following injection of either caffeine or saline solution. His controls of the experimental conditions as well as of his sleep, food, activity, and time of day at which tests were made conformed to standard requirements. Under caffeine his solution of problems per hour was 10.2 gross and 9.8 net; under saline solution it was 9.5 gross and 9.0 net. This gives an advantage of 7 per cent gross and 9 per cent net to the caffeine periods. The investigator considers the difference too small to justify the assertion that caffeine improves the capacity to solve chess problems. Still the amount of change is of the order of that found in simpler mental functions, and creates at least a presumption in favor of a facilitating effect upon this function.

CAFFEINE TOLERANCE

The question of tolerance to caffeine has been raised by a number of investigators, among them Gilliland and Nelson in the study just referred to, and Cheney, cited earlier. As a result of their detection of differences in the reactions of users and non-users of coffee, Winsor and Strongin (*705*) used the secretion of the parotid gland as an index of caffeine effect and found a gradual reduction in the secretion of this gland from drinking a pint of coffee daily. The effect appeared in about fifteen minutes after administration. In six weeks all his subjects had developed "a fairly effective tolerance." Individual differences were pronounced. It seemed, too, that tolerance developed for a given daily amount, so that if the amount were increased a new tolerance curve would result very similar in form to that for a lower dosage. It is obvious from this and other investigations that degree of habituation is a factor that must be controlled if acceptable results are to be expected. This conclusion should put all investigators of the action of any drug equally on their guard.

OTHER EFFECTS OF CAFFEINE

Hollingworth (*271*) collected evidence concerning the effects of caffeine on sleep and general health, when rigid experimental conditions are in force. Extremely large individual differences were discovered. For most of the subjects, doses of 1 to 4 grains did not affect the quality or quantity of sleep, although there were a few individuals whose sleep was impaired. With doses of 6 grains, however, the sleep of most of the persons was disturbed although even here there were exceptions. The greatest effect was always obtained when the drug was taken on an empty stomach. The most important factor in producing the individual differences seems to be the body weight. As far as general health is concerned, certain effects were manifested when the doses were larger than 4 grains. Headaches, dizziness, feverishness, irritability, and the like were reported, especially by the subjects lightest in weight.

This survey of the effects of caffeine may appropriately close with the statement of Hollingworth which remains unaffected by all the research that has succeeded his work of 1912 (*271*, 165-166).

> The widespread consumption of caffeine beverages under circumstances in which and by individuals for whom the use of other drugs is stringently prohibited or decried seems to be justified by the results of experiment. But it should be emphasized that the results of the investigation here reported bear only on the more or less immediate effects of caffeine on performance. It is true that the investigation as a whole covered a period of forty days, and that

in the intensive experiment the effect of single doses was traced for a period of three days But the results cannot be carried over bodily to the question of the continuous use of the drug One can only assume that if the constant use of caffeine in moderate amounts would prove deleterious, some indication of such effect would have shown itself in the careful study of performance in tests covering a wide range of mental and motor processes, a wide range of doses and of individuals, and of time and conditions of administration Nor can anything be said, on the basis of these results, concerning the physiological or neurological effect of caffeine, except in so far as integrity of structure can be inferred from unimpaired function or performance.... It should be further pointed out that ... tea, coffee, and other caffeinic beverages ... contain a variety of other substances which may be supposed to enhance or neutralize or otherwise modify the effect of the caffeine content. Many of the results commonly attributed to these beverages undoubtedly come, in so far as they can be demonstrated at all under controlled conditions, from these non-caffeine ingredients.

PSYCHOLOGICAL EFFECTS OF BENZEDRINE

The newcomer among drugs in the field of psychological research is Benzedrine Sulfate (*224*). Spragg (*575*), in his survey of drug research covering the last ten years, lists only two studies in 1936, nine in 1937, four in 1938, seven in 1939, and eight in 1940. The active interest in this substance arose from reports of its pronounced effects upon mental and motor functions. Its universal effect was thought to be a facilitation of performance with increased satisfaction in work and with no subsequent state of depression. Research has not borne out all these expectations, but there does seem to be good evidence for a temporary increase in efficiency in a variety of activities following a moderate dose. There is also some evidence for the postponement of the need for sleep and without any discomfort. "Too large" a dose may destroy some or all of these beneficial effects. Two or three sample studies will illustrate the present status of research on this substance.

A clinical study of 200 cases, normal and abnormal, by Reifenstein and Davidoff (*514*) leads them to the conclusion that the effects of benzedrine may be expected to be variable, uncertain, unpredictable, and at times paradoxic. The reasons are to be sought in part in the several actions of the drug upon the central nervous system, the sympathetic system, and possibly other components of the nervous system. These factors are in addition to individual differences in susceptibility.

Thornton, Holck, and Smith (*636*) have made an interesting comparison of the effects of benzedrine and caffeine upon a series of nine psychomotor functions. Three persons served as subjects. They received indistinguishable capsules containing either 20 milligrams of benzedrine sulfate, 300 milligrams of caffeine sodium benzoate, or lactose. The tests performed were steadiness; simple auditory reaction time (A.R.T.I); simple auditory reaction time with an irregular pre-

paratory signal (A.R.T.II); visual choice reaction time (C.R.T.); tapping for thirty seconds, for two minutes, and for five minutes; momentary handgrip (Grip I); and sustained handgrip (Grip II). Some of the data are given in Table 31, which shows the percentage of change from the control for the caffeine and for the benzedrine for each of the three subjects, absence of sign meaning improvement and a minus sign meaning impairment.

Inspection of this table reveals the fact that in every task all subjects did better under benzedrine than under the control, the greatest advantage being in steadiness and Grip II and the least in the reaction-time tests. Under caffeine all subjects did better in all tests except steadiness and simple auditory reaction time. Most of the differences shown in the table are reported as statistically reliable, the least reliable being the data from the reaction-time tests. The results for caffeine conform with the findings of other investigators in showing a decrease in steadiness.

TABLE 31

CHANGES IN PERFORMANCE AFTER TAKING CAFFEINE AND BENZEDRINE *

Tests	*Per Cent Change Due to Benzedrine*			*Per Cent Change Due to Caffeine*		
	1	2	3	1	2	3
Steadiness	41	58	48	−23	−21	−6
A R T I	5	2	6	−1	−2	9
A.R T. II	6	5	6	1	3	13
C.R T.	3	4	2	2	1	6
Tapping, thirty seconds	15	9	7	6	5	5
Tapping, two minutes	11	11	17	5	4	16
Tapping, five minutes	12	13	20	4	4	14
Grip I	2	8	9	2	4	8
Grip II	9	121	58	5	30	31

* Adapted from G R Thornton, H G O Holck, and E. L Smith, "The Effect of Benzedrine and Caffeine upon Performance in Certain Psychomotor Tasks," *J. of Abnorm. (Soc) Psychol*, 1939, *34*, 96-113.

In contrast to these effects of benzedrine upon simpler functions is the conclusion arrived at by McNamara and Miller (*419*) concerning a more complex mental function. They investigated the effect on six subjects of 20 milligram pills of benzedrine against a control of lactose pills upon the rate of multiplying three-place numbers by three-place numbers. They conclude that

On the average, the number of problems completed in a twelve-minute testing period is not materially increased or decreased by the administration of benzedrine sulfate, and the number of errors is unaffected.

There was, however, a subjective feeling of "increased stimulation" experienced for several hours, with the maximal effect noticeable within one hour. There is a feeling of not being tired, but the experimenters report a "nervous condition" which for a given size of dose varies with the weight of the subject.

INDIVIDUAL DIFFERENCES IN SUSCEPTIBILITY TO DRUGS

Individuals differ in susceptibility to the effects of drugs, as common experience and experiments both show. It has been suggested that these differences are greater than should be expected from a knowledge of the general facts of human variability and that real idiosyncrasies are detectable. The basis of such supposed idiosyncrasies is not clearly understood, and many different factors are probably involved. Hollingworth (*270*, 321-333) has offered the theory that susceptibility is related to general mental competence as embraced in the concept of general intelligence. The more susceptible individuals are those whose original ability in the tests employed is inferior. Those whose normal records are superior and who display the ability to improve notably through practice most successfully resist the influence of the drug on performance in the tests. It is just these abilities which are commonly taken as indications of relatively superior intelligence. Resistance to drugs, as well as freedom from neurotic involvement, characterizes the superior organism. It might be added that along with the resistance to drugs there goes the freedom from the tendency toward excessive use of such drugs, as a trait of the superior organism. At least such is the case if the interpretation of drug addiction as result rather than as cause is to be accepted. Such considerations as these give an increased importance to drug studies and suggest that experimental pharmacopsychology may make significant contributions to our more general knowledge of human nature.

12

Principles of Vocational Adjustment

The reality of individual differences, their universality, and their amount, together with the variation among occupations in their functional requirements make adequate adjustment between man and his work an ever-present problem.

The selection, for particular kinds of work, of those persons whose adjustments are adequate, and the analysis of occupations to determine just what specific adjustments are required, constitute vocational psychology. Not every kind of work can be done equally well by every individual, hence misfits in vocations are constantly occurring. Incompetent persons are placed in responsible positions or otherwise competent persons are placed at tasks for which they may be found to have either no inclination, a strong dislike, or perhaps no particular aptitude. Such "misfitting" contributes largely to high labor turnover, with its consequent loss to the employer through inefficient service, and through the necessity of constantly training new workers, and with its tendency to discourage and dissatisfy the worker and engender in him shiftless habits.

The results of poor vocational adjustment are so generally evident that all sorts of devices have been sought and tried out in order to fit the worker to his appropriate task. Impressionistic interviews, analysis of photographs, letters of recommendation, letters of application, application forms, phrenological and physiognomical descriptions, and numerous other diagnostic aids have in turn been tested and found to be either utterly absurd or manifestly inadequate to determine general or specific fitness. The need for an immediate remedy has led in recent years to the construction of tests and measuring scales which frequently have been as inadequate as the older methods because of hasty construction or because of content entirely unsuited to the purpose. Under the circumstances it seems advisable to seek for certain very general principles according to which the various methods may be evaluated. An attempt will be made in this chapter to formulate tentatively several general rules (*498*). Whether these shall deserve

the name of general principles will be left an open question for the present. First, however, it is necessary to examine several terms which are commonly used in discussing vocational problems and the implications of which are frequently misunderstood.

VOCATIONAL SELECTION AND VOCATIONAL GUIDANCE

Vocational selection means choosing a person for a particular job. There is one job but more than one candidate. In order to select the candidate correctly, the traits required for the job must be known, and means must be at hand for discovering and measuring these traits in the candidates. Vocational guidance, on the other hand, means choosing the occupation for which a given person is best fitted. There is one individual and a variety of jobs from among which to choose. Strictly speaking, the guidance of an individual would presuppose a knowledge of all the requirements for every possible occupation and would at the same time require a means of detecting the presence in the individual of every function that all of these jobs require. Sound vocational guidance, therefore, is of necessity exceedingly difficult and laborious in comparison with selection. The latter is feasible today in a number of the simpler occupations, whereas the former must be approached with misgivings.

Shortcuts through the laborious process which guidance calls for must be found, and some progress is being made to that end. Several of these are promising enough to be mentioned.

1. One of the most immediately helpful developments is the analysis of occupations into the *functions* necessary for their performance. This is known as functional job analysis, a difficult process and only beginning to be done.* When such analyses have been made, occupations can be grouped into families according to similarity of function rather than according to superficial resemblance. Just how many families would result from such a treatment of the thousands of jobs listed by the Bureau of the Census is not known. An individual calling for guidance would then be directed to a certain job family, after which a more intensive study could be made within that family. There would be many other uses for such family classifications. For instance, the ill-effects of technological unemployment could be ameliorated by the knowledge that a given person who had been working satisfactorily

* For instances of functional job analysis *see* "Job Descriptions for the Retail Trade" prepared by the Job Analysis and Information Section, Division of Standards and Research, United States Department of Labor, 1938.

in one occupation could be expected to shift readily to the other occupations within the same job family.

2. Interest might be used as the indicator which would show to which family of jobs a candidate should be directed. If one accepts interest as a fundamental factor in success, and if one can measure it adequately, then satisfying the interest demand would greatly reduce the number of families to be canvassed in any given case.

3. Intelligence, also, could serve as a classifier by showing the family level for which a candidate's intelligence would qualify him. Other job families could thereafter be disregarded as too far above or too far below the individual's capacity for satisfactory adjustment. The value and the limitations of this use of intelligence records will be discussed in Chapter 15.

4. It would seem as though some means should be sought for reducing the labor of analyzing the individual for the degree of presence of the many functions which jobs demand. The ideal solution here would be to break down behavior into a series of fundamental functions that could be matched with or related to the job functions. Efforts are being made to analyze the so-called mental organization into a series of fundamental traits. The traits thus far derived do not resemble occupational functions very closely, nor, on the other hand, is the relationship entirely remote. The primary abilities derived by Thurstone (*642*) and others are such, for instance, as ability to deal with words, with numbers, and with space relations. If there should turn out to be fifteen or fifty or even 100 of these primary abilities or functions, the guidance task would be to find which of these a given occupation or family of occupations called for and in what proportions. An individual could, therefore, be tested for the presence of these required functions. Something of this sort is now being done although the behavior functions which are measured are not in any sense primary. The outcome is a series of occupational patterns, showing how much of each of the components is needed. Stead (*580*) and his associates of the United States Employment Service have made the most consistent effort to develop occupational patterns of the sort described. This promising development will be discussed in greater detail in Chapter 16.

In spite of these various means of easing the task of vocational guidance, it is and will remain a more difficult and laborious process than vocational selection. The two forms of vocational service differ also in the consequences of error. In vocational selection the employer will know, at least approximately, the risk that he runs of making a mistake. At the worst he will have to choose and train a new employee. But the cost of error for the individual in the choice of his

work may be serious and even irreparable where a long course of training is involved. By far the largest share of calls for vocational service is for individual counsel or guidance. Confusion between these two forms of service may lead to undue optimism concerning the help that can be obtained and to consequent disappointment in the result.

NATIVE AND ACQUIRED CAPACITIES

The troublesome question of what is native and what is acquired in human behavior has a practical bearing upon psychological methods employed in vocational work. The distinction that is frequently made is between potential capacity or capacity for development and acquired capacity or proficiency which embraces what the individual has been able to learn as a result of his native capacity plus whatever training he has received. It is impossible to make a sharp distinction between the potential and the actual, and yet such distinction as can be made is useful. For instance, two candidates apply for a position of typist. One has had very little training and the other has had an extensive special training. The latter will make a better immediate showing than the former, and yet the former might, in the course of very little additional training, far outstrip the competitor because of a higher degree of inherent capacity. An employer who wanted immediate service of a given standard would choose the trained candidate, but one who preferred a candidate with great possibilities of growth would certainly choose the other.

It is generally a much simpler task to measure acquired accomplishments than potential capacities, for one knows at once in what terms the measurements of the former are to be made. To measure typing ability it is necessary only to measure samples of typing performance. But in order to measure potential capacity for typing the proper measures are not so obvious, and in fact the functions that would have to be tested might bear no resemblance whatever to the typing operation. In all cases of vocational selection for ultimate achievement and in all cases of genuine vocational guidance, the native capacities rather than acquired accomplishments need to be measured. Here again we find the burden of vocational guidance heavier than that of vocational selection.

CRITERIA FOR VOCATIONAL INSTRUMENTS

The vocational psychologist will readily confess that there are many facets to the work of vocational counseling that are not psychological and with which he is not particularly competent to deal. An important

aspect of counseling rests upon adequate information about job opportunities, job trends, the geographical distribution of jobs, the wages paid, the relative health hazard, and the chances for advancement. None of these directly involves psychological techniques or subject-matter. The vocational psychologist will also acknowledge that there are many vocational measuring instruments which are not of his making, but that may nevertheless be rendering useful service. He will insist, however, that their utility be subjected to the same severe tests as his own measuring devices. And he will suggest that the psychologist may be able to introduce improvements into these standard techniques by applying what has been learned from the development and testing of psychological measuring instruments. What then, are the requirements that these measuring instruments should satisfy? Three very general requirements will be offered as tentative vocational rules. Each one of them will have to be justified by a critical examination and the exceptions to its applicability noted.

1. Measures of Conduct or Behavior.—The first of these requirements is that the trait ultimately measured shall be a conduct or behavior trait and not some fixed anatomical characteristic. Apparent exceptions to this rule will, doubtless, readily come to mind. For instance, the quality of the musculature of a candidate for blacksmith's helper may be the proper characteristic to measure, but surely this is an anatomical trait. It would be a good measure, however, only if it indicated strength and endurance, which are behavior traits. Again, the lines of the face may be thought of as anatomical characters, yet it is conceivable that they are the results of habitual forms of facial expression and hence useful for certain particular purposes as prophetic of behavior. Physical and anatomical peculiarities, when direct indicators or determiners of conduct, will conform to our first rule. There are many physical characteristics that, as far as can be detected, have no direct relationship with the conduct in which the vocational psychologist is interested, or in fact, with any form of conduct whatever. Among these are the texture and pigmentation of the skin and hair, the color of the eyes, the conformation of the skull, the distance between the eyes, and other facial dimensions.

The investigation into the functions of the internal secretory organs and their relation to physical development on the one hand, and to the development of mentality on the other hand, might seem to suggest the practical utility of anatomical indicators. These findings have great scientific interest but there is scarcely any hope of their practical application. Where the relationship between structure and conduct has not been actually zero, it has been so slightly positive as to make impossible any prediction for vocational purposes (*485*).

There is one other possible exception to this rule that deserves consideration. A tall, robust individual may make the best "doorman," and the same type of man may make a better executive than one possessing all other traits to the same degree, but who is small in stature. As a matter of fact it appears from one survey of the physical makeup of executives (*225*) that they are taller and heavier than the average man. There is little doubt that a similar survey of doormen would bring like results. Wherever the main function of the incumbent of a position is to serve as an ornament, physical traits would play an important part. But such interpretation will not cover many cases other than that of doorman. If there is a general expectation among people that tall individuals are good executives, that expectation would in itself account for the greater height of executives, since they would in part be chosen for the possession of that trait. But more than this, it might conceivably make them better executives. For the success of an executive, in so far as his work involves relations with other people, depends upon the attitude of others toward him, their submissiveness, and their confidence in him. Such a belief in the greater executive ability of large individuals, although erroneous, would have some effect if sufficiently widespread. The possibility of any general prevalence of such beliefs is remote. The point should be noted, finally, that there is a logical fallacy involved in the notion that, because executives are above the average man in height, therefore men above the average height will make better executives than shorter men.

2. *Significant Forms of Conduct.*—The second rule is that the conduct or behavior that is measured shall be *significant* for the vocation in question. Omitting physical and anatomical traits, there is in conduct an unlimited range of material for vocational measurement purposes. This is especially true if the term conduct is extended to include, as it should, conduct crystallized in work done, words written, and features molded and shaped through frequent activity and use, if such be possible. Not every form of conduct, however, will serve as an indicator of particular vocational aptitude. In fact there are many forms of conduct that have no diagnostic value whatever for any known purpose.

An employment manager examining a candidate for the position of salesman may note the way he enters the room, the appearance of his clothing, his manner of shaking hands, the way he settles into his chair, his flow of conversation, or a dozen other forms of behavior. Are these vital factors in salesmanship? They may be, since that occupation demands social contacts, the making of a good impression, and the arousal of confidence. On the other hand, if the employment manager happened to be selecting a filing clerk, these same traits might have no significance, since that is not an occupation depending for success

upon effective social contacts, but presupposes the possession of other talents. The significance of the behavior trait cannot always be determined by mere inspection, or the task of the vocational psychologist would be much simpler than it is. Only painstaking investigation will reveal, in most cases, those forms of conduct that are indicative of any particular vocational aptitude. The methods of determining their significance will be dealt with in succeeding chapters.

3. *Adequate Measures of Conduct.*—The third rule is that the measurement of the significant conduct shall be adequate. If, for example, it should be found that ability "to look a person in the eye" is a significant indicator of the type of aggressiveness required in salesmanship, it will not be sufficient to say that one can or cannot do this. It is not necessarily a characteristic that is either present or absent, but one that exists in varying degrees. It will be necessary to determine how long and how steadily one should be able to control the movements of the eyes in order to be called aggressive. It will be necessary also to find whether ability to stare another person in the eye and aggressiveness are so closely related that the presence of one trait can be predicted with a high degree of probability from the presence of the other. In the same way, it may not be sufficient to say that a candidate has a vigorous and vital handshake, but that it is more so than that of the other candidates. So it is with all the other characteristics that are measured for vocational purposes. It is seldom if ever merely a matter of "Yes" or "No," but rather of "How much?" or "How many?" Answering such questions as these demands the use of quantitative measuring methods comparable in many respects to those used in the physical sciences. Some of the important devices for these purposes will be illustrated in later chapters.

FIRST IMPRESSION

It is pertinent to inquire to what degree the customary and widely used employment methods meet these three requirements. No established means of guidance and selection should be discarded until its lack of utility has been thoroughly demonstrated, even though it does not bear the obvious ear-marks of a test. For in the final analysis, the line between what is a test and what is not a test cannot be sharply drawn. The difference is frequently one of technique rather than of content.

Many employers of men boast of their ability to judge correctly the fitness of an applicant for a job upon the first impression that he makes, his gait, his manner of speech, the appearance of his clothing, the warmth of his handshake, and the way in which he meets a rebuff.

These are forms of conduct and a quick survey or estimate of them is possible. Is the conduct thus observed significant? To the extent that the conduct is an adequate representation or sample of the future work, as in selling, secretarial work, and some kinds of executive duties, it may possibly be significant. If, on the other hand, the applicant is being considered for a position as accountant, clerk, or skilled mechanic, the case is not so clear. We are then no longer dealing with samples of the occupation but with more or less remote symptoms. First impressions cannot be considered significant until proven so, and they are almost certain to be found of little value for all but a very few occupations.

In applying our third rule it is necessary to inquire whether the measurement of the conduct in these first impressions is adequate. Does the employment manager properly gauge the impression that the applicant will make upon his customers, if he is to be a salesman? He is very likely not to. The unchecked reaction of any one human being in a case like this is likely to be subject to a great variety of prejudices. Dislike of red hair, of a long nose; a preference for blonds, for tall persons, for snub noses, and other non-significant traits may have a subtle influence on the judgment. That such distorting influences are at work seems plausible in the light of the results of interviews such as are presented in Table 32. As it is not likely that all persons will be subject to the same idiosyncrasies, the reactions of more than one person would seem to offer a better measure of fitness than the opinions of just one. Since the efficiency of the applicant will depend upon the impression that he makes upon the general run of his customers, the nearer the judges come to forming a sample of these customers the more satisfactory will their opinion be. That employment manager whose reactions to an applicant will be representative of those whom the individual is to serve is, doubtless, rare.

A further question arises as to the terms in which the judges shall record their impressions so that their opinions can be combined in usable form, and so that the recorded judgments shall be fine enough to discriminate among the various applicants. Some kind of predetermined marking system should be employed which will be equivalent for the different judges. Finally, it may be necessary to specify certain qualities that the judges are to look for so that overemphasis may not be placed on any one trait such as neatness of dress or carriage, and so that equally important traits may not be excluded entirely from consideration. The application of the three rules to estimates from first impression shows, therefore, that such judgments would be effective only in the few instances, if any, where first impressions are vital factors in success, and only there when they bulk so large as to con-

stitute a significant sample of the whole job, when these impressions are obtained by a sufficient number of observers, and recorded in suitable fashion, and when weight is given to each quality according to its relative importance.

When the first impressions gained from actual contact with the candidate are replaced by impressions gained from a photograph, as is sometimes the case, the effectiveness of such judgments becomes still more questionable. The real conduct indicators are almost, if not entirely, missing and physical characteristics take their place. Where personal appearance is a vital factor in success, it may be determined to a certain degree from a photograph. But even such a trait as neatness can be estimated from a photograph only with considerable error.

THE PERSONAL INTERVIEW

Very closely related in general character to the method of first impression is the interview. It may be merely a means of getting an impression, and questions may be asked for no other purpose than to afford a good opportunity for observing the reactions of the applicant. But very often the interview is intended to do more than this. It may be so conducted as to elicit information concerning the individual's past, his interests, desires, and capacities which are thought to have a bearing upon his future success. When of this type, the interview must satisfy the requirements of a good measuring instrument. It should, first of all, deal with conduct and records of conduct. Whether the conduct thus investigated is significant for the purpose is a question that must be determined specifically for each occupation. For in this case one is no longer dealing directly with an actual unit of the kind of activity the candidate is to engage in, such as making a favorable impression, but with symptoms, more or less remote, of capacity to do certain kinds of work. One cannot prophesy safely, without a checking up, whether, in salesmanship for example, certain information about a candidate's past will have any bearing upon his future success, or still less, what is the relative importance of the various items of information thus obtained.

That interviews which do not comply with such rules as have been described are failures in a large proportion of the cases is suggested by the few experimental tests which have been made of them. Where equally qualified employment managers are allowed to use their own interview methods on the same group of candidates, the discrepancies are surprisingly great. It is not uncommon for the same applicant to be reported by one interviewer as the best of a group of fifty candidates and by another as the poorest in the group. More frequently still there

is no agreement as to whether a given applicant shall be placed in the poorer or better half of the group.

Hollingworth (*272*) gives the data from such a test in which fifty-seven candidates for positions as salesmen were interviewed by twelve sales managers of high standing and arranged by each in an order according to the impression created. Samples are given in Table 32. Position 1 means the best candidate and Position 57 means the poorest candidate. Reading across the table discloses the different ratings given

TABLE 32

VARYING RESULTS FROM INTERVIEWS

Applicant	*Sales Managers*											
	1	2	3	4	5	6	7	8	9	10	11	12
A	33	46	6	56	28	32	12	38	23	22	22	9
B	36	50	43	17	51	47	38	20	38	55	39	9
C	53	10	6	21	16	9	20	2	57	28	1	26
D	44	25	13	48	7	8	43	11	17	12	20	9
E	54	41	33	19	28	48	8	10	56	8	19	26
F	18	13	13	8	11	15	15	31	32	18	25	9
G	33	2	13	16	28	46	19	32	55	4	16	9
H	13	40	6	24	51	49	10	52	54	29	21	53
I	2	36	6	23	11	7	23	17	6	5	6	9
J	43	11	13	11	37	40	36	46	25	15	29	1
K	18	5	55	37	57	16	34	6	46	13	38	26
L	7	20	6	1	1	10	3	7	17	2	2	26
M	18	45	26	9	51	43	33	29	46	32	37	26
N	2	15	6	28	7	45	24	40	40	17	30	48
O	18	42	19	2	16	4	14	51	32	45	31	26

a candidate by the various sales managers. Candidate C, for example, is rated as best by one manager and poorest by another. Other candidates made almost equally discordant impressions. In actual practice such errors are not discovered directly and immediately because of the lack of any adequate check upon selections. Not only is there no means of discovering the good candidates who failed to be employed but there is no tendency to attribute rapid turnover to the selection of the wrong individuals.

THE LETTER OF APPLICATION

The letter of application may be looked upon as a means of submitting a conduct record at long range. Sometimes it serves as a substitute for the personal interview and sometimes as a preliminary device for classifying applicants into "possible" and "impossible." In either

case, to be entirely effective it must comply with the three rules laid down in the beginning of this chapter. In ordinary practice one who is writing a letter of application is left entirely free to choose the character and content of the letter, and upon the basis of it a general opinion of his fitness is obtained. Or, he may be asked to answer specific questions as to his past experience, marital status, age, and interests. If the application is of the former type, all that has been said in our discussion of first impressions will apply. Certain additional difficulties must also be taken into account. First, there is the question of the veracity of the applicant. It is not uncommon for an applicant to have some one else prepare his letters or deliberately to falsify the contents. This matter cannot well be checked without considerable difficulty. Then, too, there is the question of the ability of the applicant to judge himself rightly in regard to the matters upon which he reports. Self-estimates do not have a high degree of accuracy, and the errors that are made are usually biased in favor of the individual. It does, however, appear that one who possesses a trait to a high degree can estimate that trait in himself more accurately than one who possesses the trait to a low degree (*280*, 81-100). These statements refer to the judgment of personal character traits and not to such objective facts as age or previous experience.

It is possible that one may glean some evidence concerning the personal qualities of the letter writer from his choice of paper, his orderliness and neatness, the kinds of statements he makes about himself, and his style of expression.

When the letter of application provides information to be evaluated rather than offering merely a basis for gaining a general impression, it should be dealt with just as the interview data are dealt with. That is, the significant facts must be selected from the non-significant and these must be weighted according to their relative importance as symptoms of success. Furthermore, the personal bias of the judge must be eliminated by having the letters read by more than one person. When these conditions are complied with, there is no doubt that the letter of application may be of some service. In the experiment of Poffenberger and Vartanian (*506*) where twelve competent judges evaluated each of twenty-five letters of application for a given job, and the consensus was calculated for all the judges, this consensus was correlated with the actual capacity of the twenty-five people (as estimated by those who knew them in their work) to the extent of +.50. The correlations for the separate judges, however, varied from +.24 to +.57. In this study the honesty of the applicants was guaranteed. Each one was left free to choose the contents of his letter. Personal bias of the individual judges was eliminated by a consensus of the twelve judges. When due

weight is given to the safeguards mentioned and when the *limitations* of a letter of application are recognized, there is no reason why it should not be a useful tool in vocational selection.

LETTERS OF RECOMMENDATION AND TESTIMONIALS

In the case of letters of recommendation and testimonials a third party is introduced into the situation, which constitutes a new source of error and one that is difficult to control. Assuming for the moment that no new error is introduced by way of the writer of the testimonial, then exactly the same conditions apply as in the cases previously discussed. Significant conduct properly measured so as to eliminate personal prejudices and weighted according to its importance provides useful material for vocational selection.

The writer of testimonials and letters of recommendation is likely to view his task rather lightly and for mere accommodation will often exceed his knowledge or falsify it in writing about a friend or associate There is no way of checking against errors of this nature except to know the character of the writer and to demand testimonials from a number of persons. In the majority of cases this is not possible. Even where actual dishonesty or carelessness are not present, the fallibility of human judgment will play a part. Testimonials most frequently deal with the personal traits of an individual and it is in just such cases that the error of judgment is greatest. One observer who has written many letters of recommendation comments on them thus:

> They are often sealed with a shrug and opened with a smile The letter may be only one way of speeding the parting guest The enthusiasm of the writer may indicate only his joy over a separation long overdue.

Chassel * made a study of the effectiveness of the letter of recommendation when used under the most favorable circumstances. Letters written by members of the staff of a Teachers College on behalf of sixty-four prospective teachers were read and evaluated by 124 judges, themselves teachers or employment experts. After a number of years of teaching service the success of these sixty-four persons was estimated on the basis of position held. What is the relationship between the probable success of the candidates, judged from the letters, and their actual success? If the two sets of data are arranged into an *order of probable success* and an *order of actual success*, respectively, their relationship may be expressed in terms of a coefficient of correlation. When correlations are computed between the *consensus* concerning success and the *order for each individual judge* of probable success, they are found to

* C. F. Chassel (unpublished).

cover a range from + 01 to +.67. The author concludes that no blanket statement can be safely made as to the value of letters of recommendation. Much naturally depends upon the character of the letters themselves, and upon the person who reads them. The question is also raised as to whether the writer puts into a letter the meaning he intends and whether a reader gets out of the letter what the writer put into it.

PERSONAL-HISTORY RECORD

When a letter of application becomes transformed into answers to a series of specified questions, and especially when the questions are submitted to the candidate in a standardized form, it scarcely warrants the name of letter. It is rather a personal-history blank. In so far as the items of information called for are behavior events, they have potential value. Just what the significance of any item or series of items is for a given purpose cannot be known without investigation. In spite of the importance of knowing the significance of the personal data that appear regularly on employment questionnaires, the matter has been given relatively little consideration. This is owing in part to the failure to see the need for such research and in part to the serious difficulty of providing adequate criteria against which to evaluate the items. Goldsmith (*220*) found the relationship between success as an insurance salesman (in terms of earnings) and certain information of a biographical character such as is usually contained in a personal-history record Items of personal history were checked against success or failure after one year of service, success and failure meaning a record above or below a certain critical sales record. Such matters as good health, time spent in the work, amount of schooling, status, and motive for taking up insurance selling seem to have no bearing on success; whereas having children, starting work on commission, belonging to clubs, and having outside recreations seem to bear a positive relationship to success. Slightly different techniques were employed by Manson (*393*) and by Russel and Cope (*535*). Although disagreeing in details, these studies confirm the conclusion of Goldsmith that the value of any personal item cannot be found from casual observation, but its significance must be derived from careful analysis. These studies represent a form of job analysis which suggests what might be done and is being done in connection with many types of occupation.

Even after forms of significant conduct are discovered they must be made the basis for carefully prepared questions whose answers should be capable of simple and easy record in their entirety and be free from the factors of guessing and personal bias of the interviewer. These answers may then be dealt with adequately and be objectively measured

so as to get from them their maximal significance, instead of being passed on at the moment of the interview.

Furthermore, it is scarcely likely that all items of conduct will be found to be equally significant, hence suitable measures of significance must be employed. Perhaps "having some outside recreation" may be only one-fourth as indicative of insurance selling ability as "having children," or perhaps their relative importance may be reversed. That is to say, the various items of information must be given weights in accordance with their importance as symptoms of success. The following are a few relative weights attached to facts of personal history as worked out by Goldsmith for one business organization: age (within a given range), 3 points; marital status, 1 point; schooling (specified number of years) 3 points; previous occupation (within a certain group), 1 point; length of time with last employer, 1 point. These are matters which can be determined by one who is skilled in current statistical procedure and may put value into interview data which are worthless when not thus handled.

PHRENOLOGY AND PHYSIOGNOMY

There remain to be mentioned certain methods resting upon the interpretation of anatomical characteristics which in the light of our present knowledge have no relation, either direct or indirect, with conduct. Such methods are used in business and industry to an extent that amazes the scientifically minded student. They seem to be only one step removed from an appeal to the astrologer, a recourse that is today not infrequent. The technique employed violates all the requirements of a diagnostic test. The reported successes are extremely difficult to verify and if they do occur they are most likely attributable to the adoption of conduct measures, either intentionally or unintentionally, in place of the anatomical ones ostensibly used. A striking instance of this intermingling of the phrenological and behavior traits is seen in a certain scheme to be used by salesmen in dealing with their customers. For, in addition to noting such matters as skin color, convexity or concavity of profile, shape of head, and texture of skin, attention is directed to the wide-awake or sluggish manner, heartiness of handshake, firmness of walk, and the shrewdness of eye. One even finds in this particular instance a suggestion of measurement, for in sizing up a given customer it is noted that he is blond, "about 40 per cent on the color scale."

A certain amount of hesitation is perhaps warranted before throwing overboard entirely the notion of a usable relationship between physical characteristics and behavior traits. As stated in an early part of this

chapter, the actual correlations thus far found are too small to serve as a basis of prediction, yet the possibility remains that the two realms of anatomy and behavior may be linked to some common cause such as glandular activity. The low level of relationship obtained might conceivably, then, result from inadequate measures of either set of data or of both. To be sure, the psychological measures of intellect have attained rather general acceptance, but measures of personality are far less satisfying.

The formulation of a satisfactory index of body build presents a problem not yet solved. The morphological index, first worked out by Viola and later correlated with intellect and temperament by Naccarati (*458*) and by Naccarati and Garrett (*459*) and others, gave maximal coefficients of +.36, with the general run of them in the neighborhood of +.20. The question can legitimately be raised whether a still better anatomical index would give still higher coefficients. Sheldon, Stevens, and Tucker (*555*) have faced this problem and have constructed a far more refined system of measurement, on the basis of which they describe seventy-six different somatotypes or body forms. All of these types may be derived by making the prescribed measurements. Sheldon (*554*) has devised an analogous system for the description and classification of temperament. He hopes to discover a relationship between physique and temperament, and to measure the degree of probability with which the presence of the latter can be inferred from the presence of the former. Until these or other findings are reported it is justifiable to maintain an open mind upon this important matter. Sheldon, Stevens, and Tucker (*555*, 4-9) give an inkling of the relationship between physique and temperament that can be expected to materialize, in the following correlations:

Basic Aspects of Physique	*Basic Aspects of Temperament*
Mesomorphy: predominance of muscle, bone, and connective tissue	Somatotonia. will to exertion, exercise and vigorous self-expression
Endomorphy: soft roundness of body and digestive viscera dominant	Viscerotonia. love of comfort, relaxation, sociability, conviviality, and sometimes gluttony
Ectomorphy: linearity and fragility, large brain and central nervous system, large sensory exposure to stimulation	Cerebrotonia: sensory and central nervous system dominant with symbolic expression

DOMINANCE OF OPINION IN VOCATIONAL METHODS

The common factor in these samples of the usual methods employed in vocational service is the high degree to which conclusions rest upon

opinions, estimates, insights, or even upon "hunches." One reads a letter of application and forms an opinion; he conducts an interview and forms an opinion; or he reads a letter of recommendation and forms an opinion. Nothing is done that resembles a process of measurement. The suggestions that were made for improving the process were in the direction of standardizing the material, standardizing the procedure, and introducing precautions against prejudice and carelessness. However, opinions variously derived are relied upon so universally in the social sciences and elsewhere that a more careful study of them is necessary. Is a hunch ever trustworthy, and if so, what are the factors that make for valid hunches? Do some persons give more valid opinions than others, and if so, why? Does the quality of opinion differ with the subject-matter or are some persons just generally good judges? Are the combined opinions of two or three persons better than the opinion of only one? If so, how much better and why? The next chapter will be devoted to an attempt to answer such questions as these.

13

The Rôle of Opinion in Vocational Adjustment

The survey, in the preceding chapter, of the common employment methods shows to what a great extent opinion and judgment enter into them. It shows, furthermore, that opinions have some validity as behavior indicators, and that this may be increased by the adoption of simple modifications in procedure. There is no reason to believe, at present, that the extension of test methods in vocational work will eliminate entirely the need for such opinions. There are at least two reasons why this is true. In the first place not all human traits lend themselves to objective and quantitative measurement. Some have objective and stable manifestations such as the ability to do arithmetic computations, to write on the typewriter, to file cards, or to turn out work on a lathe. They leave a record in the form of answers to problems, sheets of typed material, cards filed in their proper places, and correctly machined work. Other traits are much more subjective and illusory in nature, such as intelligence, honesty, aggressiveness, and perseverance. Their objective records are less tangible and less easily evaluated. Even more subjective are cheerfulness, loyalty, refinement, and many other traits that readily come to mind. These are social traits and exist only as they make an impression upon one's associates, and they reflect themselves most directly in the opinions of those with whom one comes in contact. The objective traits of the first sort and a few of the second have been subjected to measurement by means of tests. Those of the third kind have not yet been found susceptible to such treatment. Yet the importance of all of these so-called character and temperament traits in determining success in any vocation is unquestioned. Consequently, until better means are developed, and perhaps always in some cases, these traits will have to be measured in terms of judgment and opinion.

The second reason why judgment and opinion will play a large part in vocational psychology is that they enter at some stage into

the construction of every vocational test. The development of tests by any of the methods in current use requires standardization upon a group of people who are *judged* to be good, medium, and poor in the trait in question. Those tests are diagnostic which are well done by the people *judged* to be good, and poorly done by the people *judged* to be poor. Even in the development of the intelligence test, which has come to be treated as a rather objective measure, judgment has entered at many points. To quote from Thorndike (*634*, 12-14):

> Our present measurements of intelligence rest on human judgments of value, judgments that product A is better or truer or more correct than product B, that method C is preferable to method D, or that C is right, while D is wrong, and the like.
>
> In some cases this is so clear that every one must admit it. Thus, in three of our best tests of intelligence, giving the opposites of words, completing sentences by supplying omitted words, and answering questions about a paragraph read, we make elaborate keys assigning credits to the different responses. These keys are obviously made by human judgment of the value of each response. The credits given may represent valuations by the truthfulness or wisdom of the answers, by their grammatical form, by their rhetorical excellence, by their originality, by the rate of producing them, or by a subtle sense of their significance as evidence of intelligence.
>
> In some cases the value is assigned so easily that we may thoughtlessly assume that the response indicates intelligence regardless of any process of evaluation. For example, we may consider that in a test in arithmetic computation or problem solving, the right answers are signs of intelligence regardless of what anybody thinks. A little thought will convince us, however, that in such tests the human judgment acts as truly as in a completion or paragraph-reading test. The main difference is that, having once for all decided that right answers are better than wrong answers, we do not raise the issue about any particular answer. We simply assume or make a general rule of valuation. The valuation becomes obvious if we collect all the responses made to an arithmetical task and ask whether all the different rights are equally good or right, and whether all the different wrongs are equally undesirable.

Since, therefore, judgment is a necessary tool not only in the measurement of those functions for which tests cannot be devised, but also in the construction of our most objective tests, it is important to know the conditions under which judgments will have the highest degree of reliability and validity. It will be important to find out also how judgments of high quality can be most readily obtained for practical vocational purposes.

MEASUREMENT BY OPINION

The terms *opinion* and *judgment* have been used interchangeably thus far, although the term judgment has not been employed in its technical psychological meaning. Opinion is the far better word to

express the intended meaning, but the use of it is awkward because its verb form *opine* is not in common usage, though acceptable according to *Webster's* Dictionary. *Opinability* and *opinable,* referring to the capability of being judged, would be very useful if more commonly used. The term *opinionare* has been coined recently to describe a questionnaire calling for opinions. The word *opinionate,* meaning to give an opinion, and the word *opinionation,* meaning the process of giving an opinion, would be most helpful in avoiding circumlocutions. In order to simplify descriptions, the terms *judgment, judge,* and *judging* will be used in the sense of opinion, one who gives an opinion, and the process of giving an opinion, rather than in their strict technical meaning.

Measurement by means of judgments is not essentially different from objective measurement. In fact it would seem that all measurement, no matter how objective it may appear to be, must have originated in judgments or estimates of more or less, better or worse, higher or lower, warmer or cooler. It is difficult to imagine, for example, how the thermometer could have been invented unless people had felt now warmer, now cooler, and if some astute mind had not noticed differences in the volume of physical objects as he felt warmer or colder. When such a correlation had been noted, then a scale could be prepared with one extreme at the volume where the inventor felt very cold, and the other where he felt very warm. With these two extremes determined, intermediate volumes could be indicated to as fine a degree as desired. A thermometer devised by Galileo was very much like this. A globe containing air was attached to a narrow U-tube open at the end, and partly filled with a colored liquid. This liquid would stand at a certain level depending upon the barometric pressure and the temperature. When the temperature rose, the air in the globe expanded and drove the colored liquid farther down the tube. Thus, changes in temperature were read from the changed position of the surface of the colored liquid, and the distance between the extreme positions was divided into a number of degrees or units of amount. There were no fixed points on this scale and differences of temperature thus determined were merely relative differences. Much of the judging with which this chapter and the one following it are concerned will be of this crude relative sort. But it is, nevertheless, measurement.

A great advance in the accuracy and stability of temperature measurement came with the setting of fixed points of reference from which the amounts of more or less could be measured. And the same will be true of our psychological estimates. Fixed reference points, particularly an absolute zero, are being earnestly sought for intelligence and other mental traits (*637*). Before criticizing the psychologist too se-

verely for his halting efforts in this regard, it should be recalled that even in the case of temperature measurement the evolution toward a fixed reference point was slow and full of pitfalls. Newton devised a thermometer one of whose "fixed" points was the temperature of the human body! Even the temperature at which water freezes is now known not to be a fixed point of reference except under the most circumscribed conditions.

The judgments or opinions with which the applied psychologists are concerned are judgments of more or less, even though some form of rating scale happens to be employed for the purpose. Expanding the term *measurement* to include such "more or less" estimates, the question may now be raised, "What behavior traits can be measured?" The answer will be found in the often quoted statement of Thorndike that whatever exists must exist in some amount, and whatever exists in any amount can be measured. This means that anything can be measured, if not on an absolute scale, then certainly in terms of more or less. The name "Order of Merit" was given to this type of measurement in 1902 by Cattell, for the case in which a series of objects or qualities was presented for ranking in an order according to value in some respect. One of his earliest uses of the method was for the evaluation of scientific merit (*98*). Since that time the method has been used for measuring the greatest variety of tangible and intangible qualities, among them the coöperativeness of school teachers, the effectiveness of advertisements, the beauty of picture post cards, the aesthetic quality of odors, poems, pictures, and musical compositions, and the intelligence of men.

QUALITIES TO BE MEASURED MUST BE DEFINED

Even though the order method may lend itself to the measurement of any quality whatsoever, it is to be expected that some values can be measured more readily and more effectively than others, and that certain conditions must be satisfied in order to obtain the highest quality of measurement. One of the most important conditions for good judgment and at the same time one of the most frequently neglected is that the trait or quality to be judged should be accurately identified or defined. It may seem strange to lay down this particular requirement for judging, when the most frequently and most successfully measured quality, intelligence, has not been defined in any adequate fashion. However, it should be recalled that much of the controversy and confusion surrounding the history of intelligence measurement might have been avoided if an adequate definition could have been set up. As it was, the mere failure to distinguish between the popular and

the scientific use of the term, because of the lack of a definition, was a handicap to progress in intelligence measurement. Real progress came under the operational definition that intelligence is what the intelligence tests measure. As long as the same test was used it seemed obvious that the same function was being measured, and thus the concept of intelligence has gradually acquired stability.

The measurement of qualities by means of opinion alone is even more dependent upon a definition, since there is no test content to give needed uniformity. The meaning of the concept resides in the mind of the judge. If that meaning is not put there by definition, it may be one peculiar to the individual judge and shared by no other person. Under such circumstances it would not be feasible to obtain a consensus of a number of judges, since the values would not be comparable. A simple instance will suffice to illustrate the difficulty. "Personal appearance" is one of the most frequently rated characteristics and almost as frequently undefined. Now personal appearance may mean one or any combination of the following: manner of dress, neatness, physical form, good looks, carriage or bearing, intelligence, or approachableness. If each of seven judges evaluated a different one of these qualities, a consensus with respect to "personal appearance" might well be meaningless. The importance of this matter rests in part upon the fact that getting a consensus of judgments is the simplest and most effective means of improving value judgments, as was pointed out in the preceding chapter. Wells (*695*), many years ago, saw the need for accurate specification of characteristics to be rated and set a pattern which has been followed by too few since that time. He defined a term by asking a series of specific questions about it, and the trait was evaluated by answering the specific questions. Thus he presented the trait "adaptability" (in children):

1. How get along with other children?
2. How get along with people in older years?
3. How conformable to discipline?
4. What tendency to be guided by advice?
5. How resourceful?

Rugg (*534*) adopted the same method in a system for evaluating teachers. He presented "teamwork" thus: to what extent—

1. Does he coöperate with other teachers in school activities? (Committee work, Parent Teachers Association, etc.)
2. Does he contribute to faculty meetings?
3. Is he loyal to the administration and to other teachers?
4. Does he suggest plans for group improvement of the school?
5. Does he shoulder responsibility for his own acts?
6. Do pupils go to him voluntarily for advice and conference?

7. Does he go out of his way to advise and help students?
8. Does he acquaint himself with pupils' home conditions where it is wise?
9. Does he participate in community activities outside the school?
10. Are his records and reports in on time and in complete form?

Scott (*544*, 212-236), in a rating system for business and industry, specified his qualities to be rated in a similar but more compact form:

Coöperativeness: Consider his ability to make his department a smooth-running part of the factory as a whole; consider his interest in the work of other departments, his understanding of their problems, his willingness to coöperate in easing work of superiors and other foremen.

A clear recognition of the need for a sharp definition of traits to be judged is apparent in the work of Stevens and Wonderlic (*583*, 126). They define "work habits" thus:

> Some men are very industrious. They are prompt at work, persistent in solving their problems, careful of details, and display that type of intelligent performance which gives the manager confidence in them, as dependable, thorough workers.
>
> Other men are not so industrious. They do not display extreme interest or satisfaction in their work They give up too easily on hard problems. They are careless of little things and cause the manager to feel uneasy He is not sure that they have expended the utmost intelligent effort in the performance of their tasks.
>
> In between these extremes are found varying degrees of work effectiveness. Please make your estimate of the men on what you have observed from working with them.

None of these is, doubtless, a perfect definition of a quality to be judged, but all four stand in sharp contrast to one that lists 193 trait names in alphabetical order without definition of any sort. Here are a few taken from the beginning and end of the list: accuracy, activity, affability, aggressiveness, alertness, virility, vivacity, wariness, will, willingness.

DETERMINING THE GOODNESS OF AN OPINION

The one final and infallible way to determine the goodness of an opinion is to check it against the truth. If the opinion coincides with the truth then it is a valid opinion. This is in essence the customary method of determining statistical validity. There is the serious obstacle to the use of this method in the case of judging that in most instances there is no independent way of finding the truth other than by the very judging process that is in question. There have been a few studies reported in which independent measures, more or less objective in character, have been available. Hollingworth (*267*, 9) had a group of ten

judges rate a series of five advertisements for persuasiveness. Their relative values had already been found in terms of actual returns from their use. His results are shown in Table 33. Although no one of the ten judges gave an order of persuasiveness that was correct, the consensus of these judges gave an order that agreed exactly with the order of value when measured in returns.

TABLE 33

THE VALIDITY OF A CONSENSUS *

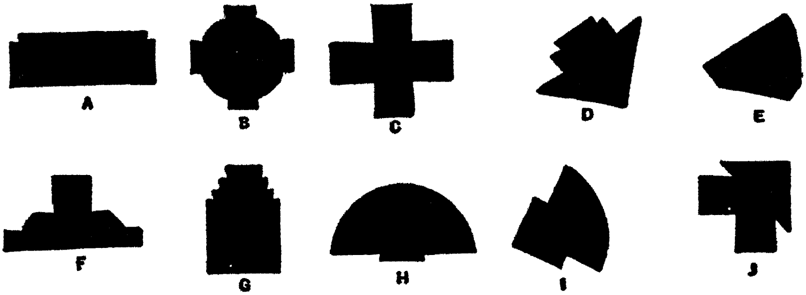
Advertisement	*Reactions of Ten Judges*										*Average*	*Order of Value*	
												Test	Returns
A	4	3	2	3	2	3	4	4	4	1	3 0	4	4
B	5	5	1	4	5	1	1	1	1	2	2 6	2	2
C	1	1	3	1	4	2	2	2	3	4	2 3	1	1
D	2	4	5	5	3	5	5	5	5	5	4 4	5	5
E	3	2	4	2	1	4	3	3	2	3	2 7	3	3

* From H L Hollingworth, *Advertising and Selling* (New York, D Appleton and Co , 1920), p 9.

In order to check value-judgments against accurately and objectively measured dimensions, Poffenberger (*501,* 104) prepared fifteen irregular forms, appearing as black on white. Each one differed from the one next to it in size by only 5 per cent, a difference that is just on the threshold of perceptibility. Ten of the forms lettered from *A* to *J* are shown in much reduced size in Figure 60. When one attempts to ar-

FIGURE 60

JUDGMENTS OF AREA



range these forms in the order of their size he lacks the usual means for such comparison. Their irregular shape makes superposition, either actual or in imagination, worthless, and their similarity in area is too great to give a clear-cut impression of difference. Placing them in an order means reacting to rather vague feelings that this one is larger or

that one is smaller, just as a person may have a vague feeling of preference for one necktie rather than another without being able to rationalize the choice. The rankings for the ten objects by twenty-five judges are given in Table 34 where the objects are arranged according

TABLE 34

ESTIMATES OF RELATIVE SIZE OF OBJECTS BY TWENTY-FIVE JUDGES *

Judge	*Object*									
	C	*H*	*A*	*B*	*G*	*I*	*D*	*J*	*F*	*E*
1	1	4	5	3	7	8	2	10	9	6
2	1	5	2	3	4	7	9	6	10	8
3	1	2	4	3	6	8	5	9	7	10
4	1	2	3	4	5	9	6	8	7	10
5	1	4	2	5	3	6	8	7	10	9
6	5	6	2	3	1	4	9	7	10	8
7	1	4	9	6	2	7	3	5	8	10
8	2	1	3	4	6	7	5	10	8	9
9	1	8	7	2	3	5	6	4	9	10
10	1	4	6	2	3	7	5	8	9	10
11	2	4	8	1	3	5	6	7	10	9
12	3	1	6	2	9	7	4	5	10	8
13	1	7	6	2	3	8	4	5	9	10
14	2	5	6	1	4	8	3	7	9	10
15	1	2	3	5	4	8	6	7	9	10
16	4	5	6	1	2	8	3	7	9	10
17	1	9	7	8	6	5	4	3	2	10
18	1	2	4	6	3	9	7	8	5	10
19	1	7	2	4	9	6	3	8	5	10
20	1	2	6	4	7	5	3	9	8	10
21	1	3	4	5	2	6	7	8	9	10
22	1	3	5	2	4	7	6	8	10	9
23	1	4	5	2	3	7	6	8	10	9
24	3	2	5	1	4	7	8	9	6	10
25	1	3	2	4	5	6	7	8	9	10
Average ...	1.6	4.0	4.7	3.3	4.3	6.8	5.4	7.2	8.3	9.4
Rank order.	1	3	5	2	4	7	6	8	9	10
Actual order	1	2	3	4	5	6	7	8	9	10

* Adapted from A T Poffenberger, *Psychology in Advertising* (New York, McGraw-Hill Book Co, 1932), p 106

to size, with *C*, the largest, on the left and *E*, the smallest, on the right. The consensus of the twenty-five judges, in terms of the average position assigned to each object, is given in the third from the last row of figures; the ranking derived from these averages is given in the next to the last row; and the actual order of size is given in the last row.

It will be seen from casual inspection that the largest, *C*, and the smallest three, *J*, *F*, and *E*, are correctly placed and that all the others except *A* and *B* are in error by only one position. *A* and *B* are each in error by two positions. The correlation between the correct and the judged order is represented by a coefficient of +.92 when computed by the Rank Difference method. Whether one depends upon mere inspection or prefers the coefficient of correlation, it is evident that the consensus gives a close approximation to the correct order. It should be noted that this degree of correctness is obtained from the combined judgments of twenty-five persons, and that no two persons agree exactly in their rankings. (The correlations of the individual rankings with the true order vary from 0 to +.98.) This experiment, in which hundreds of judges participated in addition to the twenty-five here reported, comes as close to an actual objective check on the Order Method as it is possible to make. However, it is distinctly unfair to the method, in that what the method purports to measure is the effect of some set of conditions, situations, or qualities upon a judge, a group of judges, or a whole population. In that sense, then, it might be legitimate to say that whenever the judges represent a fair sampling of the population whose reaction it is desired to measure, the consensus of their reactions *is the correct measure.*

VARIABLE "ERRORS" OF JUDGMENT

The most significant characteristic of judgment or opinion is the variation from person to person. The reason for this is to be found in the fact that the outcome of the judgment depends not only upon the object or person or trait being judged, but also upon the characteristics of the judge himself. It is, for example, conceivable that the neatness of an individual will be estimated very differently by one who is exceedingly neat and by one who is exceedingly slovenly, while, of course, the object of the judgment remains the same. Such differences among the judges in reacting to the same situation are usually but mistakenly called "errors." On account of these variations introduced through the individuality of the judge, it is seldom if ever safe to rely on the judgment of one person in vocational measurement. There is the danger that the judgment will be too strongly colored by the personality of the judge. When the opinions of a number of judges are combined by the proper statistical methods, the peculiarities of the individual judgments are ironed out. This is certainly the case when the "errors" thus introduced are "accidental" or variable errors, that is, when any one of them taken at random is just as likely to result in overevaluation as underevaluation of the trait. In such a case the "error" of some judges

will be offset by the "error" of other judges, with the result that the consensus of all will give a measure more nearly correct than that of any individual judge taken at random.

In experimental studies where there is some objective measure against which to check the results of judgment, the greater validity of the consensus is evident. For instance, in the study of the diagnostic value of letters of application (*506*) described in the preceding chapter, the coefficients of correlation between the judgments made by eleven individuals and the criterion are as follows, all of them being positive:

.24, .30, .34, .38, .40, .46, .49, .49, .53, .56, .57

The average of these coefficients is .43. But the correlation of the consensus of the eleven judges with the criterion is .56. There is only one judge who gives a better result than the group taken as a whole. Similar findings were cited on page 251 for the estimates of sizes of objects.

The dependence upon one judge in vocational work lays the whole procedure open to criticism. The individual reactions to letters of application, letters of recommendation, and personal interviews are subject to a variety of errors owing to personal idiosyncrasies, likes and dislikes, changing moods and feelings of the judges. No single change in employment procedure will bring about so much improvement as the recognition of individual differences in judgment and the need for a consensus. And yet serious practical difficulties are often encountered in satisfying this requirement for safe judgments. For example, in a department store the evaluation of the characteristics of sales people and clerical workers frequently must rest upon the judgment of one buyer or department head who is the only person in a position to judge. In the public-school system, too, it is very difficult to get more than one or probably two supervisors who are capable of judging the qualities of a group of teachers. From the studies of judgment that are available, it would seem that three independent estimates of the traits commonly judged is the minimal requirement for satisfactory work. In many cases where the variables affecting the judgments are numerous, the number should be even larger. For certain kinds of work, such as evaluating advertising devices, no less than twenty-five judges is usually considered adequate.

CONSTANT "ERRORS" OF JUDGMENT

The "errors" made by individual judges are not always of this accidental sort. Sometimes they are "constant errors," that is, there is

some influence at work that tends to make the judges err in the same direction. It will be evident that, in such a case, increasing the number of judges will not eliminate the "error." It should be noted that the term *constant error* may be used in three senses. In the first sense, the error appears only when there is a check against some objective or physically measured criterion. In this case the term *error* is inappropriate, if what is desired is a measure of human reaction to the situation. In a second sense, the term is used to indicate distortion by some influence acting upon human reactions themselves to modify what would otherwise be the true reaction. As an illustration of the first, take the opinions of twenty-five judges concerning the relative size of area *G* in Table 34 that was actually fifth in size in the series of ten specimens. These opinions placed the object in the following positions:

7, 4, 6, 5, 3, 1, 2, 6, 3, 3, 3, 9, 3, 4, 4, 2, 6, 3, 9, 7, 2, 4, 3, 4, 5

It will be observed that sixteen of the twenty-five judges rated the area larger than it really was (1 indicates largest and 10 indicates smallest), seven rated it smaller, and two judgments were correct. There was at work in these judgments a "constant error," an optical illusion due to the shape of the figure which made it appear larger than it really was (*88*, 369). Although this "constant error" creates a discrepancy between the physical measure and the judgment measure, for certain practical purposes the judgment measure may be the correct one. In such a case it would be a mistake to attempt to eliminate the "error." For instance, if an attempt was being made to find a container for a food product which for a given actual content would look the largest, it would be defeating the purpose of the test to eliminate the illusion of size. Likewise, if one were attempting to measure cheerfulness, the judgment might well give a more valid measure than some complicated measure of glandular or other physiological activity, since the result desired is the *impression* of cheerfulness created by the person upon others.

The results of an unpublished study by the writer of the relative intelligence of fifteen men as judged from their photographs illustrate the second kind of constant error. Intelligence was also measured by means of one of the best intelligence tests. The relationship between the orders of intelligence determined in these two ways was found to be negative. The greater the actual intelligence the less did the estimated intelligence appear to be. When the number of judges was increased, the negative relationship became more and more pronounced. There was a "constant error" present that turned out upon investigation to result from the confusion on the part of the judges

of *good-looking* with *intelligent.* In most practical circumstances in which judgment is employed there is no actual or correct measure against which to check the judgments. Therefore it is important to discover by any means available the presence of constant errors of this second type so that they may be eliminated or some method found to correct for them.

One of the most frequent sources of the kind of "constant error" that should be avoided is the so-called "halo" effect (*617*) or "atmosphere" about an individual which may influence one's judgment of him in any trait whatsoever. One's general impression of a person is likely to color all his judgments of particular traits. Thorndike and others have shown by the correlation method that all traits in an individual show a much closer apparent relationship than they could actually have. On account of the "halo" effect, many judgments of specific personality traits turn out to be nothing more than measures of a general impression created by the individual. A clear understanding of the nature of this "error" is essential in dealing properly with it. The influence of the personal appearance of a person upon estimation of his intelligence in the case described is a good illustration of the distortion of judgment due to this cause. The devices that are employed to minimize it will be discussed in the next chapter.

Still another possible source of constant error in judging is the "personal equation," which implies a systematic deviation from correct judging through some persistent influence. The term suggests that the error could be corrected by the application of an equation, as in the case of reaction times, where a correction can be applied for a given amount of delay. Thus a judge might be overlenient, compared with other judges, in giving prison terms because of his social philosophy, or a personnel officer might overrate a friend who happened to be a candidate for a position. Or one judge may consistently rate all persons within a very narrow intermediate range of a trait, whereas another might just as consistently employ a very wide range. For example, one teacher might grade all his papers B and C, giving no A's or D's, whereas another used the whole range from A to F. Such personal tendencies as these have been recognized and various devices have been adopted for their correction. Conrad (*114*) measured the effect of correcting for this error upon the correlation between judgment and a criterion. When he combined estimates of two or more judges he found that correction for the personal equation made a difference too slight to be practically significant. He recommends a consensus of a number of judges as the simplest way to deal with such errors.

DO HUMAN QUALITIES DIFFER IN THE CORRECTNESS WITH WHICH THEY CAN BE JUDGED?

The statement has been made earlier that anything that exists in any amount can be measured, which is equivalent to saying that anything can be measured. The further statement was made that, from one point of view at least, the consensus of a proper sampling of judges will be an acceptable measure. Now the consensus is some form of statistical combination of the opinions of the separate judges, frequently an average. It will be immediately obvious that perfect agreement among judges is not to be expected, nor is an equal degree of agreement in the evaluation of all qualities to be expected. Such agreement as does occur is taken as evidence that the opinions do "stand for some actual quantitative value and are not subject to mere chance." It is, therefore, pertinent to inquire whether human characteristics differ in the correctness with which they can be measured. And the answer would seem to be that degree of correctness of measurement would be indicated by degree of agreement among the judges. A far more direct and straightforward means of finding the validity of opinion measurement would be to check against the objective truth, but there is no such objectively true measure for the characteristics with which we are concerned.

Hollingworth (*279,* 133-142) has extensively employed this idea of degree of agreement as the measure of correctness, and has developed the concepts of objectivity and subjectivity and of the physical and the psychological on the same basis (*277*). He worked over the data of earlier investigators and derived a list of twenty-four traits which could be arranged in an order according to the degree of agreement with which they can be judged, or according to their "objectivity." Divided into four groups, with the first group being the most objective and the fourth the least objective, they are:

Group I	*Group II*	*Group III*	*Group IV*
Efficiency	Perseverance	Clearness	Usefulness
Originality	Judgment	Mental Balance	Integrity
Quickness	Will	Intensity	Coöperativeness
Intellect	Breadth	Reasonableness	Cheerfulness
	Leadership	Independence	Kindliness
		Refinement	
		Physical Health	
		Emotions	
		Energy	
		Courage	

The fact was noted many years ago that the traits about which inquiries are made in recommendation blanks sent out by teachers' agencies, employment bureaus, and employers, are those upon which opinions show the least agreement, that is, those which are the most subjective. Degree of agreement or objectivity-subjectivity is not, however, to be conceived as a fixed characteristic of any trait, but as the resultant of a combination of factors. There is evidence to show that it varies considerably with the circumstances. Slawson (*569*) who studied the ratings of school teachers by their supervisors, found that coöperativeness, a trait that fell in Hollingworth's Group IV, showed a very high degree of consistency among the judges. There is good reason to expect that coöperation of teachers with supervisors would be a more obvious and observable phenomenon than coöperation among a group of college students. But even within the same supervisor-teacher relationship, coöperativeness showed a variation in objectivity in different schools, in terms of relative position in a group of six traits, as follows:

School	I	II	III	IV	V	VI
Average position	3.5	5.0	1 0	4.5	5.0	3.5

These figures mean that although for one group of teachers coöperativeness was the trait most consistently judged (School III), for another (School V), it was one of the least consistently judged. It seems then that objectivity or degree of agreement is a variable quantity, and that comparisons of traits in this respect would be meaningless unless the conditions under which the opinions were to be obtained were specified and controlled.

WHAT CONSTITUTES A GOOD JUDGE?

The fact that individuals differ so much among themselves in their judgments of personality traits, and that a part at least of such differences is due to the characteristics of the judge himself raises the question as to what constitutes a good judge. Assuming that consensus means correctness, a good judge would be that one who conformed to the consensus, and the best judge would be that one who conformed most closely to the consensus. Although the data at present available on the question of the factors affecting judgment are meager, it appears that not only do individuals differ in the quality of their judgment of a given trait, but that the same individual differs in the quality of his judgment of different traits. Thus the ability to judge appears to be a highly specialized function within the individual (*272*) (*291*, 220-

228). Table 35 contains material that shows clearly both these types of variation. The figures are in terms of coefficients of correlation between an individual's judgment of twenty-five people and the consensus about these twenty-five people (which is taken as the correct measure). The coefficients are given for ten judges concerning the three traits, intelligence, neatness, and sociability. Reading down any one column will disclose the degree to which the judges differed one from the other in their estimation of the trait named at the

TABLE 35

INDIVIDUAL DIFFERENCES IN THE QUALITY OF JUDGMENT*

Judge	*Intelligence*	*Neatness*	*Sociability*
A	.51	.11	39
B.	.11	.10	08
C.	.15	.29	.05
D.	—27	06	.49
E.	.08	24	08
F.	43	.41	.28
G.	.04	.11	.02
H.	39	09	.32
I.	22	08	.00
J	30	02	.55

* Adapted from H L Hollingworth, *Vocational Psychology and Character Analysis* (New York, D Appleton-Century Co, 1929), p 75

head of the column; reading across the page will show how the individual judge varied in ability to estimate the three different traits. For instance, the relationship between the estimate and the criterion for intelligence varies for the different judges from —.27 to +.51, whereas for Judge D the coefficients for the three traits vary from —.27 to +.49.

It is logical to assume that to be a good judge of a trait in others one should possess that trait to a high degree, or that within certain limits the more of a trait one possessed the better judge he would be of that trait in others. In organizations where there is no highly developed employment or personnel department, the applicants for a given job are selected by the experts in that line of work. Where selections are made by an employment office, it is done not so much because of a lack of confidence in the expert as it is to bring about a centralization of function. Although a question of great practical importance is involved, there is little experimental evidence at hand concerning the relative effectiveness of these two methods. One bit of data may be obtained from Hollingworth (*280*) in terms of the correlation between the possession of a trait and the ability to judge that trait within a group of

twenty-five people. The figures are given in Table 36 for a series of nine traits. All the coefficients except one are positive, although many of them are very small. In fact, none is so high as to justify the choice of a judge for a given purpose solely on the basis of his possession of the trait to be judged. This point is far more significant than the differences in the degree of relationship for the various traits. One might well expect that intelligence would be a potent factor in the quality of judgments that could be made. The data that are available show that the possession of intelligence does not make one an especially good judge of the intelligence of others, although intelligence gives the next to the highest correlation in the table. It is doubtful, indeed, if the possession of intelligence would be a more potent factor in judging other traits than it is in judging intelligence itself.

TABLE 36

RELATION BETWEEN THE POSSESSION OF A TRAIT AND THE ABILITY TO JUDGE IT*

	Coefficients		*Coefficients*
Neatness	.22	Vulgarity	—.24
Intelligence	.49	Snobbishness	33
Humor	59	Refinement	.38
Conceit	19	Sociability	48
Beauty	23		

* Adapted from H L. Hollingworth, *Vocational Psychology and Character Analysis* (New York, D Appleton-Century Co, 1929), p. 98

Adams (2), with a technique very similar to that of Hollingworth, attempted to discover what are the personality characteristics of the good judge. He employed eight teams of ten girls each, and the members of any one team evaluated each other and themselves in a series of sixty-three personality qualities and fourteen physical qualities. Adams, like Hollingworth, accepted the average of the rankings as the most probable "record of truth." Having done this, he then proceeded to compare each individual's capacity to judge (by checking his record against that of the group) with the degree to which he possessed the various traits (as determined by the consensus of his associates). Whereas Hollingworth reported a general tendency toward overestimation of desirable and underestimation of undesirable traits, Adams classified his judges into over-, under-, and correct estimators, the percentages being respectively 46, 36, and 18. He then collected the group estimates concerning the overestimators and found them to present a consistent picture "of a stupid, antisocial, weak willed, self-centered person who suffers at the same time from self-consciousness and lack of self-confidence." He gives no corresponding picture of the underestimators.

In a similar fashion he found the characteristics of a good judge, first of a self-judge and second of a judge of others. The good judge of self

> . . . is interested in other persons, likes to be with them, puts himself out to be agreeable to them, is sympathetic, demonstrative, tactful, polite, and popular. The good judge of others, on the contrary, tends to be independent, takes relatively little interest in persons, appearing to be gregarious rather than social. In general, he is either negative or but slightly positive in his social tendencies To summarize. the one who can estimate himself well tends to be moderately social; the good judge of others tends to be either anti-social or indifferent.

It should be recalled that goodness of judgment meant for Adams, as for Hollingworth, conformity with the group opinion.

Vernon (*666*) attempted to improve on Adams' technique by employing a more objective measure of goodness. The subjects to be judged were measured for certain qualities by an elaborate series of tests and the judges, too, were tested for the presence of certain qualities. The goodness of the judgments was determined in terms of conformity with the measured values of the subjects, and the qualities of the good and poor judges were likewise known from these test records. He concluded that the accuracy of personality judgments depends not merely on the subject who is being judged but also on the content of the judgment and on the conditions under which the judgments are made. His descriptions of good and poor judges resemble those of Adams. Specifically he found good judges of self to be more intelligent and to possess a greater sense of humor than the average judge. Good judges of friends and associates appear to be less socially inclined and less intelligent, but more artistic than good self-judges. Good judges of strangers are found to be distinctly more artistic and intelligent than the average and, under certain conditions, more asocial.

The data of these investigators can be applied only with reservation to the task of vocational adjustment and personnel work in general. They were derived from studies of college students who comprised both the judges and the judged, and who were evaluating their associates within the frame of reference of their college associations. Over against this sort of laboratory evidence there is the less tangible evidence for general goodness or general poorness in people. An examination by Horst (*291, 220-228*) of the characteristics of the good judge shows him to be a product of sound theoretical training and extensive practical experience, who, by the processes of sympathy, empathy, recipathy, intuition, and insight, perceives and understands human personal qualities. Blumer (*49a*) finds that there are persons thus equipped who are, in fact, good judges. Their judgments have validity even when these are "hunches" in the sense that they cannot

be proved to rest upon definite and tangible evidence. It would appear, however, that such judges are specific in their proficiency and that their "good hunches" are limited to the fields of their training and experience.

Correlational studies have tended to show that good qualities go together in the long run, and particularly that with high intelligence there tend to go desirable personality and temperamental characteristics. Thus, in the long run the good judge would be the person of high intelligence with which would be associated tendencies toward fairness, good will, and generosity. Thorndike (*626*, 348-389) makes extensive use of this idea of general goodness in his applications of psychology to economics, government, and public welfare. It should be noted, however, that Thorndike (*626*) would entrust certain important functions of government *not to a trustee but to trustees.*

Our democratic system of government, which is government by the people, provides for experts in judging in the realm of law where wisdom in the form of background of information, knowledge of precedent and the like are considered essential. But it is recognized that judges are not entirely free from "constant errors" so that there is provision for appeal from the decision of such an expert. And the final appeal goes to a supreme court of a number of judges by whom a decision is rendered in the form of a consensus. In those cases which vitally concern the life of individuals, and in which interpretation of human behavior rather than interpretation of tradition is called for, democracy provides for judgments by juries, groups of one's fellowmen whose consensus is final.

DEGREE OF ACQUAINTANCE AND QUALITY OF JUDGMENT

It has been pointed out above that goodness of judgment depends in part upon conditions under which the judgments are made. A certain degree of acquaintance with the person to be judged would seem one of the conditions requisite for good judgment. In the absence of knowledge through acquaintance the judge must rely upon the indicators and clues that are so generally condemned when employed by the character analyst. That degree of acquaintance is essential which will enable the judge to know and evaluate the particular trait to be measured. The question is not so simple, however, as it seems at first, since too close an acquaintance introduces errors of judgment which differ from but may be as potent as those resulting from too slight acquaintance. The atmosphere created by close friendship or by prejudice either favorable or unfavorable is very likely to warp the judg-

ment. Slawson (*569*) found by the use of the partial correlation technique that in the long run degree of acquaintance makes no significant difference in the quality of judgments of personality. His conclusion, however, is significant (*569*, 161):

> This inability of acquaintance definitely either to raise or to lower judicial agreement becomes evident upon considering the several ways in which this factor may operate For although lack of acquaintance with one or several subjects may result in chance ratings, thus lowering the correlation between the unacquainted judge and the rest of the group of judges, intimate acquaintance between a rater and subjects may also lower the correlation between the intimately acquainted judge and the rest of the judges, by the exercise of prejudice either due to friendship or to the discovery of peculiarities in the subject which are particularly abhorrent to the rater (and probably unknown to the less intimately acquainted judges). The positive and negative influences would then in the long run tend to balance each other, that is, acquaintance would have little or no effect.

It is clear from this statement that judgments about individuals are *warped* by the degree of acquaintance and that it is only a group of judges varying in degree of acquaintanceship with the person to be judged that can avoid the acquaintance error. In most, if not all, aspects of vocational guidance and selection, interest centers in the *individual* and the question is whether judgments of value will be fair or unfair to him. Knight (*348*), using a different technique from that of Slawson, shows plainly the influence of degree of acquaintance upon the judgment in particular cases. He studied grades assigned by the judgment method to 1,048 teachers. The degree of acquaintance between the judges and teachers ranged from less than one year to more than eight years. He finds that if the difference in acquaintance is a matter of minutes, hours, or weeks, the greater the degree of acquaintance the better the judgment, but when it is a matter of years, the reverse holds. The author concludes (*348*, 142):

> The factor of acquaintance, then, operates to make ratings more lenient, *i.e.*, to increase the over-rating, and to make ratings less critical and less analytical, *i.e.*, increases the influence of the halo of general estimate. It is in the direction of truth to discount the ratings of judges when acquaintance has been long. In a way it is literally true to say of a judge's estimate: "His judgment is of doubtful validity *because* he has known his man too long."

Shen (*557*) studied the estimates made of each other by twenty-eight college students who had been classmates for three years. Among the traits were impulsiveness, leadership, adaptability, persistence, and scholarship. Taking as the correct value for each trait in each individual the consensus of the group concerning it, he compared the average error or displacement by the judges with the degree of friendship, as estimated by the individuals themselves. That is, he set up five

degrees of friendship and computed the average error in judgment separately for each trait within each degree of friendship. The differences thus obtained were negligible. However, when he made the same computations taking account of direction of error to disclose systematic deviations, he found that there was a consistent relationship between degree of friendship and tendency toward overestimation. He calls this an illusion, and considers it the inevitable consequence of the favorable position that friends occupy in one's estimation. His figures show that this constant error is small in comparison with the variable errors that may be eliminated by group judgment.

About all that can be said concerning the practical implications of degree of acquaintance is that it should be recognized as a possible source of distortion of judgment and that precautions should be taken where there is likelihood of such error. The precaution that is simplest and most likely to be effective is to employ a consensus rather than to rely upon a single judge.

JUDGING ONE'S OWN QUALITIES

The frequency with which individuals are called upon to give estimates of themselves in information blanks, letters of application, and interviews rests upon the expectation that such estimates will have a reasonable degree of validity. All that has been said earlier about the bias that can arise from close acquaintanceship would seem to apply with added force in the case of self-evaluation. Self-knowledge and self-esteem should create a "personal equation." One of the earliest observations upon this matter was made by Cattell (*96,* 542) in his measurement of scientific eminence. From the mass of judgments assembled by him, he concluded that there is no constant error in judging oneself, that one is about as likely to overestimate as to underestimate himself, and that one can judge himself slightly more accurately than he can be judged by *one* of his colleagues. He discovered individual differences in this respect, however, some persons overestimating and some underestimating themselves decidedly.

Hollingworth (*279,* 143-173), in a laboratory study of judgment in which twenty-five students judged themselves and each other for a variety of traits, compared the error of every self-estimate from the consensus in regard to each trait with the average deviation of the group judgment of him in regard to that trait. This means that an individual's error in judging himself is compared with the average disagreement among the judges concerning him. He found that a person displaced himself somewhat more from the consensus than did the individuals making up the consensus. Taking account of direction of displace-

ment so as to disclose any constant error, he found a tendency for an individual to overestimate his possession of the desirable traits and to underestimate his possession of the undesirable traits. His figures are given in Table 37.

TABLE 37

SYSTEMATIC ERRORS IN SELF-JUDGMENT *

Trait	*Error*	*Trait*	*Error*
Refinement	+ 6 3	Neatness	+ 1.8
Humor	+ 5 2	Originality	+ 1.2
Kindliness	+ 4 0	Beauty	+ 0.2
Energy	+ 3 8	Conceit	− 1.7
Intelligence	+ 3 0	Snobbishness	− 2.0
Sociability	+ 2 2	Vulgarity	− 4 2
Efficiency	+ 2 1		

* From H L Hollingworth, *Vocational Psychology* (New York, D Appleton Co, 1916), p. 155.

Hoffman (*263*) confirmed the findings of Hollingworth with the further conclusion that individuals tend to show a consistency in their degree of overestimation of the desirable and underestimation of the undesirable, which leads her to coin the expression "self-halo." Jackson (*309*) worked over the data of earlier studies of self-estimation to find whether there was a correlation between intelligence and the correctness with which one judged his own various characteristics. The correlation with estimated intelligence was +.70 and with intelligence measured by test was +.48, from which he concluded that the more intelligent a person is the better judge he tends to be of himself. He found, incidentally, that the greater the degree of conceit a person has, in the opinion of associates, the poorer is his ability to judge himself.

These results should not be entirely unexpected by the reader and should suggest that self-judgment should be taken with the proverbial "grain of salt." The obvious safeguard is to support such self-judgment with the opinions of one or more unbiased judges, and preferably more than one.

STABILITY OF PERSONAL QUALITIES

How stable are the traits which we are called upon to judge? It will suffice here to say that the stability of a trait is usually inferred from the stability of the judgments of the trait since any more objective measure of the trait is lacking. If the estimates of traits are repeated at intervals of several months, or at least long enough to eliminate the influence of memory of earlier estimates, stability may be calculated in

terms of the uniformity of judgment over this interval of time. Such a measure will tell nothing about the correctness of the judgment alone nor will it indicate the degree of stability of the trait itself. At best it will reflect a combination of these two influences. In terms of coefficients of correlation, the relationship between two such series of judgments has been found to vary from + 60 to +.80. As might be expected, the stability of the traits varies with the judge, the correlations in one study for different judges varying from +.20 to +.90. Slaght (*568*) obtained reactions from forty students to a series of seventy personal items and after an interval of two years repeated the test. He reports a surprising degree of similarity which he attributes to the reliability of the measuring device. The shifts that did appear were accounted for by increased maturity and changed environment of his subjects. This question of trait stability will be treated more fully in Chapter 17.

IMPLICATIONS OF ADOPTING CONSENSUS AS THE CRITERION OF CORRECTNESS

The material presented in this chapter shows the great reliance placed upon group reactions as the measure of correctness. What it means, stated boldly, is that the majority vote determines the right. It has already been said that this holds for group judgments where the errors that are made are of the chance or variable sort and where errors of the constant or systematic sort are missing or are present only to a minimal degree. Such conditions can be more or less assured in the laboratory, in the personnel office, and at times in the field. However, when the groups enlarge and the controls against constant errors become relaxed, the substitution of degree of agreement for validity may well be questioned. The actions of mobs swayed by emotional orators offer an exaggerated instance of the obvious failure of the method. Our democratic system of government with its decisions based upon the vote of the majority is susceptible to systematic error through the influence of pressure groups of one sort or another exerted through the radio, the press, and the speaker's platform. Much more susceptible are those populations whose sources of information are entirely under the control of the few. The consensus under such circumstances may be no consensus at all, strictly speaking, but the opinion of the few impressed by suggestion or by force upon the many. The remedy should be sought in an understanding of what conditions must be satisfied in order to make group judgments valid. They have been discussed in this chapter with reference to vocational psychology, but their range of application is far broader than that of detecting the personal qualities of candidates for a job. The one primary essential for high quality of group judg-

ment is a free flow to the members of the group of knowledge and information devoid of bias and distortion, and at a level of simplicity which shall bring it within the understanding of every member of the group. Wallas (*674*, 29-42), in his *Social Judgment*, emphasizes the need for knowledge in the making of social evaluations and stresses the difficulties inherent in acquiring the requisite knowledge. He employs the term *vertical* to suggest need for a knowledge of historical background, and *horizontal* for acquaintance with the current cross-section of events, and shows that both are essential. When judgment and opinion rest upon such a foundation as this, the reaction of the group may be accepted with increased confidence as the measure of correctness.

14

Rating Human Qualities

There are two commonly used devices for collecting with precision the data on the less tangible manifestations of human behavior. These are the questionnaire and the rating scale (*601*, 3-297). This chapter will be concerned with the latter of these for two reasons. First, the rating scale has been widely adopted and is extensively used at present in the various phases of vocational adjustment. And second, it embodies a change toward the refinement of the "more or less" type of measurement characteristic of the "Order of Merit Method."

The construction of crude scales of change in volume as indicators of temperature led the way toward the detection of finer and finer degrees of temperature change and the establishment of reference points from which such changes could be measured. Current rating scales of human traits are aimed at both of these objectives and, to the extent that they approximate them, they are achieving for the measurement of human qualities something of the stable and refined characteristics of physical measurement.

RATING SCALES AND THE "ORDER OF MERIT METHOD"

There is one important respect in which the rating scale is an improvement over the order method. Obviously the latter, which presupposes two or more objects that can be arranged in an order, is not adapted for all vocational purposes. It often happens that there is only one person to be evaluated for a given job, and in that case the method of relative position cannot be employed. This difficulty is overcome by the rating scale that provides a series of items among which the new one shall be given a standing or rating. Since the items or units or objects forming the scale can have their positions determined by the order method once for all, any new item can be measured directly by noting where it falls in the series, just as is done in measuring the length of an object against a foot rule. Thus, if the scale consisted of a series of shades of gray, and the item to be evaluated was another shade of gray, the relative positions of the shades in the series would

have been determined. The new specimen would then be "measured" by testing it along the scale and finding the place either on one of the scale units or somewhere between two of them. In such a situation the method of measurement would be essentially the order method, with the difference that, the order within the series having been previously determined, the rank of the new specimen only would need to be found.

TYPES OF RATING SCALES

A certain amount of order and simplicity can be introduced into the discussion of rating devices if they are grouped into classes and these classes described as variants from the order of merit method, beginning with those that deviate the least. This procedure will furnish a logical picture rather than an historical account of scale development, because scales did not consistently and systematically grow by moving farther and farther away from the parent form. Absence of historical perspective, however, is no serious loss for the practical purpose for which this chapter is intended.

1. Man-to-Man Rating Scale.—In the man-to-man rating scale there is the closest approach to the order of merit measurement because the man to be measured is evaluated along with other men. The units of the scale are persons known to the judge and chosen by him as possessing specified degrees of the trait to be measured. The rating scale for leadership (*656,* Vol. I., 260), as used in the personnel system of the United States Army, will serve as an illustration:

Leadership		*Name*	*Score*
Initiative, force, self-reliance, decisiveness, tact, ability to inspire men and to command their obedience, loyalty, and cooperation	Highest	....	15
	High	....	12
	Middle	....	9
	Low	....	6
	Lowest	....	3

In the first blank space is to be written the name of the officer possessing the highest degree of leadership known to the judge; in the last space, the name of the one possessing the lowest degree of leadership known to the judge; in the middle space, the name of one who stands in leadership about midway between the first two chosen. The spaces marked "High" and "Low" are for men whose leadership ranks about halfway between the middle man and the highest, and the middle man and the lowest respectively. The ratings given an officer on this scale are, therefore, in terms of his standing among these men. Standing may then be transformed into the numerical units shown at the right of the scale. Certain difficulties arise in the practical use of this scale from the fact that each judge has to construct his own scale, that is, he must furnish out of his own experience the men to occupy the various steps

on the scale. First, it is not easy to find suitable specimens without more study than one is willing to give the task. And second, since valid judgments imply the consensus of a number of judges, the scales of all the judges should be equivalent. If all judges could use the same persons for equivalent positions on their scales these would be comparable, but such agreement is difficult to attain in practice. If the scales are not thus comparable, the measures obtained from the different judges cannot be combined legitimately, hence consensus is impracticable. Rugg (*534*) made a thorough analysis of the use of this scale for the rating of army officers and reported many sources of error. Some of these are common to other types of scale also, but one was peculiar to the man-to-man scale: the use of the same individual by various raters for different points on the scale. According to Rugg

> The same man, used at 15 on one scale will be used at 12 on another, 9 on others, 6 on occasional ones, and even 3 on a few. Persons regarded as the "best captain I ever knew" were selected for positions on other scales as "the poorest captain I ever knew"

To measure human qualities with such devices would be like measuring length with a yard stick on which the numbers were jumbled into a random order. In spite of the difficulties inherent in the practical use of this form of scale, it is sound in principle and can be used advantageously in situations where identical individuals can be found by the various judges for like places on the scales.

2. *Specific-Instance Scale.*—The nature of the major difficulty with the man-to-man scale suggests a modification to avoid that difficulty. Thus it could be argued that, if trouble arose from having actual persons represent degrees on the scale, one might better use actual instances of the behavior of such persons. These would be the specific acts through which the "best captain I have ever seen" attained that reputation. Statements of this sort intelligibly expressed should carry the same meaning to every rater who would use the scale. Instead of men possessing a given trait to a specified degree, there would be specific instances of behavior representing various degrees of the trait. An example of this type of scale designed to measure the alertness of sales people is:

Scale Unit	*Specific Instance of Behavior*
1 Energetic and enthusiastic	Eager to have sale progress with little loss of time
2. Active	By quickness of movement allows sale to progress with little loss of time
3. Deliberate	Moves about at an even rate, neither speeding up nor delaying progress of sale
4. Plodding	Moves slowly, retarding progress of sale
5 Inert	Retards progress of sale because of inactivity

This kind of scale resembles the handwriting, drawing, composition, and other product scales in common use in educational work, and it has much to commend it. One difficulty arises from the necessity of having several instances of behavior at each point on the scale, so that there may be samples adequate for gauging the quality of every person to be measured. The difficulty here, however, is no greater than that encountered in the construction of educational scales. In the handwriting scales it has been found necessary to have a given level of quality represented by forward slant, backward slant, and vertical writing, as it would be awkward to evaluate a backhand specimen against a scale limited to forward-slant samples. Likewise, in the drawing scales, the samples must necessarily be specific drawings, so that several specimens of things children commonly draw, such as houses, animals, and people, are needed to stand for a given quality on the scale.

Care must be exercised to make the instances sufficiently specific to avoid the necessity for interpretation on the part of the judge. If this precaution is observed, there should be fairly close agreement among the judges as to their meaning. There is a decided tendency, however, in the making of specific-instance scales, to slip into the use of rather general instances of behavior. Such is the case with the scale illustrated above. There is a certain amount of vagueness about the word "eager" and the word "little." Would "little loss," for instance, mean about the same amount of loss in the mind of each rater? A far more specific instance would be, "On January 16, sold customer coat in three minutes." However, highly specific instances of this sort limit the utility of the scale too narrowly, unless each point is covered by a number of instances, whereas even a few instances at each point on the scale would make it cumbersome to prepare and to use.

3. Descriptive-Term Scale.—As the scale items become more and more inclusive in their meaning, a point is eventually reached where the term *specific instance* or even *instance* becomes inappropriate. The items degenerate into more descriptive phrases or adjectives of the "same, more, most" type, or of the "good, very good, excellent" type. Expressions of this sort cannot carry specific meanings of amount and, therefore, do not satisfy the requirement that the scales be equivalent for different judges. However, the ease with which such scales can be constructed seems to outweigh their shortcomings, for they are by far the most commonly used. The specimen of this form of scale given below is not a scale carelessly thrown together by an amateur but is a part of a carefully constructed rating system. It demonstrates the fact that good scales are extremely difficult to make and that even experts

may have to resort to vague descriptive terms. The scale intended to measure "Promptness" is:

Work frequently late	Work usually on time	Work always done promptly

Of the terms *frequently, usually, always, late, on time,* and *promptly,* only one, *on time,* really carries a definite and specific meaning.

Rugg (*534*) has devised an interesting combination of the specific-instance and descriptive-term types of scale. For a given trait, he asks a series of specific questions and to each question he calls for an answer in terms of *low, average, high.* (For a sample list of questions bearing on the trait of "teamwork," see page 247.) The ratings for teamwork would be derived from a combination of the ratings on all of the individual questions. This type of scale offsets the admittedly crude unit of measure with a large number of specific reactions. It has the advantage of forestalling misinterpretation by the specific character of the questions, and the simple threefold classification into low, average, and high makes the task of the individual judge easy and the ratings of the different judges fairly comparable.

4. *Numerical Scale.*—In contrast to the vagueness of adjectives, adverbs, and other descriptive terms what could be more objective, specific, and unambiguous in their meaning than numbers? For this and other supposedly good reasons one frequently finds numerical scales, carrying a series of degrees or amounts from 0 to 100. It is a simple matter to perform various arithmetical computations with scores derived from such scales, and this fact too makes their use attractive. However, both the specificity and the arithmetical exactness are apt to be spurious. "Zero carefulness" or "10-per-cent carefulness" are not concepts that are likely to have equivalent meanings for different raters, and conscientious judges are frequently disturbed at the prospect of their use. Moreover, there is grave danger of taking the numerical aspect of the scores too seriously.

One numerical scale has come to the writer's attention in which an effort was made to inject specific meaning into the numerical values. With what degree of success this has been done it is not easy to say, although upon superficial examination it might seem to have some promise. A scale for "Carefulness" follows:

Out of 100 chances to display the characteristic of carefulness, how many times will it be shown? If one is careful 95 per cent of the time, mark the 95-per-cent point on the scale, etc.

0	10	20	30	40	50	60	70	80	90	100

....

The tendency to work with numerical values is not, indeed, peculiar to the strictly numerical scales. Almost all of the scales that have their scale units arranged along a line (sometimes called graphic scales on that account) find an individual's score by measuring the distance from the zero or low end of the scale to the point marked by the rater. Whether the unit of measure be millimeters or the numbers 1 to 10 the score is a numerical value which tempts one to employ mathematical manipulation. In fact, there is no other feasible way to record and combine rating scores of this sort. One can only caution the user to be on his guard against losing sight of the nature of the material with which he is working, in order to avoid making unjustified use of it.

Wells (*695*), many years ago, seems to have sensed the risks of using numerical values in rating, and set up his rating scheme so as to make the numerical combination of records impossible. His symbols were:

Marked presence above ordinary	+ !
Distinct presence above ordinary	+
Doubtful presence above ordinary	+ ?
Doubtful deficiency	— ?
Distinct deficiency	—
Marked deficiency	— !

In recognition of the awkwardness of the notations, however, he says:

> Any quantitative method of notation may be applied to such a series of inquiries. They may be graded on a percentage basis, compared with a standard objective scale, evaluated by whatever method the investigator may prefer or the refinement of his working conditions permit.

5. *Rating with Check-Lists.*—Richardson and Kuder (*518*) devised a rating system that at first sight would seem not to warrant inclusion in a list of scales. The user sees no scales of a graphic or any other sort. He has before him a long list of specific instances of behavior and is required to check those that apply to the person being rated. He need never know that each one of the items has been given a scale value and that when he checks a certain item he is assigning a grade to the individual.

The authors were concerned with the construction of a scale for salesmanship. They collected about 1,000 statements from various sources describing the performance of salesmen on the job. After eliminating duplicates and editing, 531 statements were retained, such as "He is in somewhat of a rut on some of his brand talks." Fourteen judges familiar with the job requirements sorted those statements into seven piles, "representing seven equally spaced degrees of effectiveness on the job." This equality of spacing, it should be noted, was a purely subjective reaction and one difficult to achieve. Fortunately, departure from equality would not destroy the value of the technique. One hun-

dred and thirty-two of the statements upon whose scale values the fourteen judges agreed were used in the final scaling. The seven piles were assigned arbitrary numerical values of 10, 20, 30, 40, 50, 60, and 70. Each item was then given a value in terms of the average scale position assigned to it by the fourteen judges. The whole list of items was divided into two sets of seventy-three items, fourteen of these appearing in both scales. Further details of standardization need not be noted except to state that the items were arranged for use in a random order without scale values. All that the rater had to do was to check those statements that applied to the individual being judged. The numerical values of the statements appeared only on the scoring sheets.

This general form of scale has much to commend it. (1) A number of specific instances of selling behavior are provided for each step on the scale. With the seven original divisions, there could be as many as ten or more instances for each seventh of the scale. (2) The numerical values, having been assigned to the items by the judges in the course of standardization, should be less equivocal in their meaning than when they depend upon the rater as in a numerical scale. (3) The "halo effect" (to be discussed later) should be markedly reduced, as the judge could not readily be influenced in his later reactions by the trend of his earlier reactions.

THE REQUIREMENTS OF A GOOD RATING PROCEDURE

A rating scheme for vocational purposes or for any evaluation of personality commonly comprises a series of scales to measure a number of traits. Such a scheme may be designated as a *rating system,* and each unit within that system intended to measure one of the traits as a *rating scale.* Where only one item is being evaluated such as "sales ability," or "general value to the company," the terms rating system and rating scale would be equivalent. But the term rating scale does not seem appropriate to designate a series or battery of individual rating devices, although it is occasionally used in that sense.

Studies of rating procedures have advanced to the stage where it is possible to lay down certain requirements that every good rating system should satisfy. Not all such devices do satisfy these requirements, and certain of the requirements have not been perfectly met by any current rating system. The more important of these requirements will be discussed.

HALO EFFECT SHOULD BE AVOIDED

Precautions should be taken to minimize the effect of a general impression created by a person upon the estimate of his specific traits.

The errors that are likely to arise from this cause have been pointed out on numerous occasions, but Thorndike (*617*) forced general recognition of them by coining the expression "halo effect" to designate them. He examined the correlations among traits of aviation cadets as judged by their officers, and found them both higher and more uniform in size than could be expected. For instance, there was a correlation of +.51 between physique and intelligence, and correlations of +.58 and +.64 between the latter and leadership and character, respectively. It was Thorndike's opinion that the correlation between intelligence and physique should be no more than one-third the size of the other two. This is a striking instance of thinking of a person in general rather than in terms of his specific qualities, thereby creating a spurious relationship. Thorndike also pointed out that correlations of technical ability as a flyer with the combined ratings for physical qualities, intelligence, leadership, personal qualities, and general value to the service were too high. It was his estimate that, considering the restricted range of the cadets, the highly specialized quality of the flying technique, and the attenuation to be expected in the correlations, the coefficient should be no higher than +.25. However, these ranged for eight raters from +.52 to +.91.

IDENTIFICATION OF THE HALO EFFECT

Although this halo effect is a genuine phenomenon and one to be guarded against, it must not be supposed that all high correlations between ratings of traits are due to its influence. It frequently happens that traits included within the same rating system are actually closely related traits. When high correlations result from this cause, the remedy is to eliminate the overlapping traits, and thus reduce the size of the rater's task. The rating system prepared by a committee of the American Council on Education contained in its original draft the two traits designated as follows: "Does he need constant prodding or does he go ahead with his work without being told?" and "Has he a program with definite purposes in terms of which he distributes his time and energy?" Bradshaw (*56,* 34) reported a study of the intercorrelations among the traits of this rating system in which these two traits showed a correlation of +.96. Two other traits in the same group, namely, "How does his appearance and manner affect others?" and "How does he control his emotions?" were correlated +.31. If a general halo had been responsible for the correlation of +.96, its influence should also have spread over the other traits and should have raised the relatively low coefficient of +.31 to a much higher level.

It should not be assumed that all high correlations between a general

estimate and estimates of specific characteristics are due to a halo, with the implication that they are spurious. Stevens and Wonderlic (*583*) describe a rating system containing five specific and two general traits, the more general of the latter being "present general ability and value to the company." They say that "if our definitions of the specific and general traits are correct, a high positive correlation should exist between the separate traits and the two general traits." The correlations actually do vary from +.56 to +.77. The correlations among the specific traits themselves range from +.49 to +.72. The authors employed the technique of partial correlation (*197*, 409) to eliminate the influence of the general trait upon the specific traits and thereby reduced the size of the correlations to the range —.03 to + .18 They concluded from these figures that the halo effect, though doubtless still present, has been largely eliminated by the form of their scales.

PRECAUTIONS AGAINST THE HALO EFFECT

It is not always feasible to discover, either by inspection or by statistical procedures, just when and to what extent this halo effect is at work. But it should be noted that when two traits show a high correlation, regardless of the cause, they should not be used in the same rating scheme, if only for the sake of economy of rating. This precaution will tend in itself to put one on his guard against the influence of the halo effect. Several other precautions may be noted.

1. The traits to be rated should be as clearly and sharply defined as possible. It was pointed out by Wells (*695*) that the undue influence of general merit is most obvious in the case of those qualities that are ill defined in the minds of the judges. It is not necessary at this point to do more than mention the need for a sharp definition of the traits to be judged, since that was dealt with at length in the preceding chapter.

2. Some means should be adopted to break up or prevent the formation of any artificial trends to grade a person in a spuriously uniform fashion. The usual arrangement of scales does encourage such trends by having the zero or minimum of the trait always at the left, with the quality increasing in amount toward the right. The mere fact of having checked the first trait at a given point on the scale, invites a check in the same neighborhood of the second scale. It occurred to Freyd (*188*) that the halo might be greatly reduced by the simple device of alternating the direction of movement of the trait with the low end alternately on the right and on the left, or better still, having them vary in a less systematic fashion. He carried out this procedure and, although he did not compare the uniform arrangement of the scales with the alter-

nating, he found that the size of his trait intercorrelations, with one or two exceptions, did not exceed expectations. (The range was from —.51 to +.70.) Therefore, it seemed to him that the graphic rating scale as used by him tended to eliminate the halo.

Bradshaw (*56*, 35-39) compared two scales differing only in the positions of the high and low points, and found as Freyd had guessed that the intercorrelations varied accordingly. Their range for the uniform arrangement was +.30 to + 84 and for the alternating +.07 to +.64. Despite this finding and because of the greater inconvenience of scoring with the alternate arrangement, he advised against the use of the alternating scheme for the reduction of the halo effect.

3. The remedy proposed by Thorndike (*617*, 29) is the separation of the function of collecting the evidence from the function of rating it. In his own words his recommendation is:

> In all work on ratings for qualities the observer should report *evidence,* not a rating, and the rating should be given on the evidence to each quality separately without knowledge of the evidence concerning any other quality in the same individual.

The best way to carry out this recommendation would be to have a professional rater evaluate on scales the evidence submitted to him. Such a rater would not need to know the persons to whom the evidence referred or even which characteristics belonged to the same individual. This technique would eliminate the halo effect in so far as the rating process is concerned, although at the same time it would considerably complicate the rating system. The question arises at once as to whether the influence of the general impression would not still reside in the evidence itself, for the person who gathered the evidence might be under the spell of the halo. The answer would have to be in the affirmative, unless the evidence were in the form of very specific instances of behavior which would not readily be affected by bias, such, perhaps, as: "John Jones, on October 18, was ten minutes late to work," or "John Jones, on October 18, swore at his foreman, saying ——." Such material could be gathered and rated with a high degree of fair-mindedness.

4. The use of a check-list such as that of Richardson and Kuder (*518*), described on page 271, would seem to go far toward reducing the halo. The series of specific instances of behavior arranged in random order so far as "favorable" and "unfavorable" are concerned, and each having to be read and reacted to separately, would tend to break up any uniformly favorable or unfavorable reaction. It would not, however, entirely avoid it.

5. Still another means for counteracting the influence of a general impression upon ratings of specific characteristics is to set up *the rating*

sheet for the rating of a number of individuals on a single trait, and not for the rating of a single individual upon a variety of traits. No trend could develop in this case from a perfunctory attitude toward the task, and any general impression would have to be carried over from one rating sheet to another with the ratings of other individuals intervening. Although this arrangement of the rating material has its disadvantages in certain other respects, it has much to recommend it for practical use.

Such great emphasis has been put upon the halo effect because it is one of the constant errors that is likely to appear in all forms of judgment. It is subtle in its influence and its presence often difficult to detect. Since our earlier discussion of constant errors shows that increasing the number of judges will not in itself necessarily eliminate the error, precautions should be taken wherever possible in the very technique of measurement to reduce its influence to the minimum.

RATINGS SHOULD BE BASED UPON INFORMATION

It is needless to do more than mention the fact that ratings should be made only upon information in the possession of the rater. If one were to rate without such support, he would be open to the same criticism as the phrenologist and the physiognomist. But beyond the mere statement of the need for information, there are certain precautions that can be taken to insure its use in rating.

1. First, it should be made feasible and convenient for the judge to refrain from rating where he does not have adequate information. The scales described by Bradshaw (*56*) have at the end of each the statement "no opportunity to observe" which the rater is to check instead of the scale itself if he does not feel competent to judge for that reason. A sample of such a scale for rating Appearance and Manner follows:

Sought by Others	Well Liked by Others	Unnoticed by Others	Tolerated by Others	Avoided by Others	No Opportunity to Observe

A similar provision is mentioned also by Stevens and Wonderlic (*583*). On the contrary, it is not uncommon to find printed at the head of a rating system, "please rate all items," which will encourage the rater to disregard his lack of basis for judgment in order to comply with the instructions.

2. Should the traits be observed by the rater? Among the principles laid down by the Committee on Personnel Measurement of the Ameri-

can Council on Education * to safeguard and improve rating procedures, it is stated that "only traits observed by the rater should be measured." This is obviously intended to ward off estimates made upon mere hearsay evidence or no evidence at all. It will be recalled that Thorndike's recommendation for the reduction of the halo effect provided separately for the functions of observing and of rating, the rater to be furnished with the necessary evidence by the observer. Although there does appear to be disagreement as to how the information shall be provided, there is entire agreement as to the necessity for adequate information.

3. The rater should be encouraged to use his information in rating. It is not unlikely that a judge might rely upon a vague general impression rather than upon specific knowledge, even if this were at hand. To guarantee that available evidence would be used in making a rating and that no evaluation would be attempted in its absence, Bradshaw (*56*, 32) made provision for the recording of such evidence, which he called "Behaviorgrams," on the back of the rating sheet. His instructions were as follows:

> Describe briefly and concretely significant performances and attitudes which you yourself have observed. Let your statements answer specifically the questions of the rating scale by showing how the student manifested the qualities mentioned. Do not be satisfied with the statement of an opinion concerning matters of fact, if the facts themselves can be presented. Select those illustrations of conduct which are consistent with the personality of the student as you have observed and understood it.

These statements show clearly the effort made to elicit specific instances of behavior as evidence for ratings. The instructions also contained sample instances to serve as a spur toward specificity. One of these was: "'Independently collected and classified 100 type specimens of fossils found in the neighborhood of the college."

The use of the back of the rating sheet for this purpose gave disappointing results as it elicited almost no Behaviorgrams. When, however, the sheet was so revised as to provide space directly beneath each scale marked thus: "Please record here instances that support your judgment," the frequency of its use rose. Still, approximately 70 per cent of the judges were rating upon a general impression or else were not willing to record the supporting evidence. It is obvious that what is most needed for the improvement of ratings is some means that will guarantee the use of pertinent evidence.

SCORES SHOULD BE WEIGHTED

When some kind of composite value is desired to express an individual's standing or fitness in a group, a common procedure is simply to

* *See* Educational Record (Supplement), VIII, 1928, p. 7.

find the sum of the scores on the various scales. Such a procedure neglects the rather obvious fact that certain traits may be far more important than others for a given purpose. Some means should be found to give to each scale the relative importance that it deserves and this can be readily achieved by adopting a series of weights or multipliers for the various traits. Bills (*42*, 391), in setting up a rating system with eight scales for clerical workers, devised two independent weighting systems, one for individual work and the other for supervisory work. These were as follows:

	Weights	
	Individual	*Supervisory*
1. *Appearance.* Consider neatness of person and dress........	10	10
2. *Ability to learn* Consider ease of learning new methods..	20	20
3. *Accuracy* Consider quality of work, freedom from errors.	25	10
4. *Dependability.* Consider how well he can be relied on to do his work without supervision.......	10	10
5. *Speed* Consider amount of work accomplished...........	20	5
6. *Cooperativeness* Consider his ability to work with others..	7.5	10
7. *Constructive thinking.* Consider his ability to grasp a situation and draw the correct conclusion	7.5	10
8. *Ability to direct work of others.* Consider ability to direct work and gain cooperation	0	25

These weights were obtained "by consultation with ten division heads who from long experience were intimately acquainted with clerical work." That is, the weights were derived from a consensus of judges, the only means available since there was no objective gauge of the importance of these qualities. The need for weighting is dramatically illustrated in the difference between the sets of weights for the two functions of individual work and of supervisory work. The weights for appearance, ability to learn, and dependability are the same, but for ability to direct work they are 0 to 25. Even for speed, the weight for individual work is four times that for supervisory work.

The question might well be raised whether a composite score, even when weights are attached to the individual components of it, may not be a misleading value. For instance, the heavy weighting given to accuracy would suggest that the minimum of that quality that would be acceptable would be rather high. Yet a candidate falling below the minimum in that respect might conceivably compensate for it in the total score by high values in all of the other traits. In spite of such an acceptable total score, as Johnson (*328*) has vigorously pointed out, his qualifications would be unsatisfactory because a necessary component of success would be lacking. The logical remedy for this predicament is not to merge the individual scores, but to present them in graphic form in such a way that a bird's-eye view of them may be obtained. If at the same time one has a "master chart" showing the desir-

able distribution of the qualities for a given occupation, the one can be checked against the other and the fitness of the candidate determined by inspection. Such profiles or "patterns," as they are frequently called, will be discussed at length in Chapter 16.

RATERS SHOULD BE COMPETENT

It is now rather generally agreed that raters should be instructed in the use of their instruments, although the writer knows of no studies to determine just what the training should be or just what improvement can be expected to derive from training. There are certain things that the rater should know and there are likewise certain things he should do to insure good ratings. The following list is adapted from Bingham and Freyd (*46,* 122-142) who offer it in the course of a discussion of the construction and use of rating scales.

1. Be sure that the operation of the scales is thoroughly understood.
2. Be sure that the meaning of each ability or quality is clear.
3. Observe every person whom you are to rate and with regard to the specific abilities to be rated.
4. Consider one ability at a time and rate all persons on that before proceeding to the next ability.
5. Keep ratings of any one ability free from the influence of other abilities or of your general impression.
6. Remember that most people approximate the average, and that there are few possessing the highest or lowest degrees of the quality.
7. Keep in mind concrete instances of behavior.
8. Do not be influenced by closeness of acquaintance or friendship.

OPTIMAL NUMBER OF RATERS

One of the bothersome questions in rating concerns the number of judges necessary to insure a correct measurement. If one keeps in mind the fact that accidental or unpredictable errors of judgment are to be eliminated by using a number of judgments instead of only one, he will realize that no final answer can be given to this question. It would be helpful, however, if a safe number of judges could be specified, or if a minimum could be set below which it would not be safe to go. Rugg (*534*) has set such a limit at three judges, and this certainly should be the minimum if idiosyncrasies of opinion are to be thus canceled. Symonds (*601,* 96) computed the number of judges necessary to attain a reliability of judgment represented by coefficients of +.82 and +.90. For a list of nine human qualities such as leadership and impulsiveness, he obtained a correlation of +.82 when the number of judges ranged from two to nine for the various traits, and a correlation of +.90 when

the range was from four to eighteen judges. As the number of judges would have to be materially increased to raise the reliability much above +.90, this figure may be considered the optimum to be sought. Symonds finds eight ratings to be the average of the number yielding that degree of reliability, and thus sets eight judges as the necessary number "if the ratings are to be individually diagnostic." Since eighteen judges were needed to attain the desired degree of reliability in the case of rating Impulsiveness, it would be safe to set the optimum even higher for ratings in general, especially where one did not have exact foreknowledge of the number needed.

RATINGS SHOULD BE VALID AND RELIABLE

Enough has been said in the previous chapter to show the difficulties inherent in determining the validity of judgments, whether or not the judgments are made with the aid of rating devices. It is such common practice to determine the *validity of tests* by checking them against *judgments* that the latter often come to stand for the truth. Where this is not the case, some measure of reliability is made to stand for validity. Thus Hollingworth (*280*) used degree of agreement among judges as the indicator of *objectivity*, and Hartshorne and May (*250, 228*) define the "true" score as statistically the "average of a large number of separate and completely independent judgments." Actual validity, meaning degree of conformity with the objectively determined "correct," can be found only by some procedure such as that described on page 248, and the results reported there should be reviewed in this connection.

As to the measurement of reliability, the logic and the procedure are more straightforward although certain difficulties arise even here. As Bradshaw (*56, 52*) points out:

> If we would test the reliability of ratings by having the same raters repeat ratings after intervals of time, the additional opportunities to observe, and real changes in the subject's character might act to decrease reliability coefficients. If we would test reliability of ratings by the agreement of different raters making simultaneous ratings, the raters' varying degrees of acquaintance with the subject, their differing terms of observation, and their differing experiences by which they interpret the terminology of the scale, all tend to decrease the reliability coefficients. Only one thing can safely be said about a rating: that is, that *it records what the rater thinks about the subject,* and even here there is a possible language error factor between rater and the user of the rating.

Since practically all "reliability" and "validity" values are derived from the correlations of one judge with another or one group of judges with another group, it should be noted that these statistical values so obtained are surprisingly high considering the number of influences

that would tend to lower them. At the very least one can say that they signify a high degree of uniformity in the estimates that people can make of other people, and that the likelihood of success which vocational psychology attempts to predict depends in large part upon the behavior so estimated.

The multitude of rating scales in current use may be readily subsumed under one or another of the five types just described. Hybrid forms exist in great numbers, but they usually resemble one type more or less closely, and for a rough evaluation can be so classified. The check-list type of measuring device described on page 271 is offered as an excellent one where it can be used and where the labor of construction is not an insuperable barrier. It satisfies a large proportion of the requirements that have been cited. More convenient, however, is the specific-instance form, and when worked out, as Stevens and Wonderlic (*583*, 126) have done it, it embraces all of the good qualities that have been recommended in so far as its graphic character makes that possible. It furnishes a detailed definition of the trait; it demands evidence in support of each rating; it encourages the rater not to rate when evidence is lacking; and it provides on one rating sheet for the rating of a number of individuals on a single trait rather than for a number of traits of a single individual. It must be remembered that none of these rating systems can relieve the rater of the responsibility for serious, honest, and intelligent effort in the recording of his judgments.

One further possible means of simplifying the rating process should not be overlooked. It may come from the application of factor-analysis techniques in this field. They have already been mentioned in connection with the search for primary mental abilities (page 229) and will be referred to frequently in later chapters. Ewart, Seashore, and Tiffin (*165a*) applied factor analysis to data obtained from a rating system containing twelve separate items, and found it possible to reduce the twelve to only two essential items. "The implications of the research for industry are that when a multiple-item rating scale is adopted it is possible that the ratings will really reveal only one or two aspects of the employee's merit and not twelve or more aspects as might be inferred from casual examination of the scale" (*165a*, 486). These authors have suggested a promising lead which is sufficiently important to warrant corroborative studies. Until the suggestion has been carefully checked, the more cumbersome rating system discussed in this chapter will remain in use.

15

The Rôle of Intelligence in Adjustment

THE MEANING OF INTELLIGENCE

The need for a sharp definition of a function if it is to be measured is nowhere more clearly demonstrated than in the case of intelligence. The history of the intelligence test is a record notable for its confusion and controversy, arising in part from the conflict between the technical and the popular meaning of the word. When it was taken over by psychology for technical use, the old meaning could not be easily shaken off. "Intelligence" has meant, and still means to the majority of people, something like general all-around competence or wisdom. To say that such competence or wisdom ceases to increase after the age of fourteen or sixteen or any age short of the onset of senility seems sheer nonsense to intelligent persons not initiated into the technical meaning of the concept, or unwilling to accept it.

It would be difficult to build up a widespread acceptance of the idea that the characteristics of the intelligence test itself determined the meaning of the word intelligence. But if that could be accomplished, the oft-quoted statement that "intelligence is what the intelligence tests measure" would become more than a mere humorous remark. That is, in a sense, an operational definition of the concept, wherein the "concept becomes nothing more than a set of operations," or "the concept is synonymous with the corresponding set of operations" (*584*). Thorndike (*628*, 2) has said that the only sure way to know what the Army Alpha intelligence test measures is to examine the test itself and its scoring plan. To say that intelligence, as defined by the content of the intelligence test, ceases to increase at the age of fourteen or sixteen or any other specific age is a matter to be proved or disproved through empirical evidence, and when proved can be accepted.

Such a definition may look like no definition at all. Terman (*609*, 44) considers it unreasonable to demand a complete definition before measurement can be made, although he does say that it is necessary to be guided by some assumption or assumptions. He cites the analogy of the

electric current which was measured long before its nature was understood. Spearman (*573*, 16), however, points out a necessary distinction between the inward nature of electricity and its outward manifestations such as the movement of a galvanometer needle. Although the former need not be known any more than the essential nature of intelligence need be known, it is necessary to accept certain outward manifestations of it. This has been done in the case of the concept "electricity." Likewise the outward manifestations of intelligence or intellect should be known and agreed upon.

In practice the major disagreements have occurred in defining the inner nature of intelligence; the accepted outward manifestations, if various intelligence tests can be taken as evidence, have been surprisingly similar. The two current concepts of intelligence which contrast most sharply today are those of Spearman (*574*, 367) and Thorndike. Whereas the former defines intelligence as "the educing of relations and correlates," he quotes the latter as defining it thus:

> Let intellect be defined as that quality of mind (or brain or behavior if one prefers) in respect to which Aristotle, Plato, Thucydides, and the like, differed most from Athenian idiots of their day.

Concerning *intelligence tests*, on the other hand, Spearman (*574*) has said that he advocates the procedure of throwing a most heterogeneous assortment of tests into a single pool; and Thorndike (*628*, 237) has said that intelligence tests might draw on anything for their material including any sort of material object; any living plant or animal, including himself; any quality or relation that exists in reality or imagination; any emotion, idea, or act.

Leaving theories of intellect aside, and accepting the contents of intelligence tests as the clue to what intelligence means, it may be defined as general competence, or it may stand as a name for the power to do a large number and variety of specific things. Thereupon, an *intelligence test* could be defined for practical purposes as a standardized and graded sampling of all the various things that people can be expected to do.

ORIGIN OF DIFFERENCES IN INTELLIGENCE

Another serious source of the early confusion and controversy resided in the question whether intelligence was to be considered a native endowment of the individual not subject to increase by education, much less by mere casual environmental influences, or whether it was to be conceived as the product of environment and thus limited in an individual only by the inadequacies of his environment. In the heat of the

controversy of the 1920's, both sides stood for extreme points of view that could not be sustained by the growing body of research evidence. The confusing and complicating factor in a proper evaluation of the problem has always been the inescapable necessity of measuring intelligence in terms of learned reactions. Thus the proponents of environment could readily point to the fact that intelligence tests measured what people had *learned* to do; whereas the proponents of heredity could show that equal or equivalent environments did not produce equal degrees of intelligence. The controversy, though still active, is at present concerned with the *relative degrees* to which nature and nurture are responsible for the intellectual status of the individual. Stated thus, the problem can eventually be solved by the accumulation of data from scientifically controlled studies. A critical survey by Woodworth (*712*) in *Heredity and Environment* shows the present status of the problem, some of the methods that are being employed, and points out the direction in which research should move.

If nature is the major determining influence, then adjustment will be limited to making the most of natural endowment. If nurture is the major determining influence, the perfection of adjustment will depend only upon the extent to which the essential environmental factors can be manipulated. In the former case, increase of opportunity could raise the intellectual level of every one, while leaving the relative differences in intelligence about as they are now. In the latter case, intellectual level could be raised, and to an equal degree for all. Woodworth (*715*, 237-238) sums up the situation thus:

> When knowledge of the effects of environment has advanced far beyond its present state, our successors may be able to raise the mental ability of the whole population by the equivalent of 25 to 50 points IQ But this improvement will not eliminate individual differences nor necessarily diminish them at all. Differences in heredity make themselves felt in any environment, no matter how superior. So far as concerns the scatter of intelligence now existing in the population, the known effects of environment account for only a small part of it. Probably the major part of it is due to that intimate combination of heredity and environment suggested by the statement that each individual tends to select his own environment to suit his own heredity.

THE UTILITY OF INTELLIGENCE TESTS

The intelligence test is the most commonly used of all the psychological devices for vocational measurement. Its popularity results in part from the fact that it was the first and most convenient measuring tool that offered any hope of being serviceable and in part from the belief that some general quality, intelligence, is an indispensable requirement for success in any vocation. The distinction drawn by

Woodworth (*715*, 97-98) between intellect and intelligence gives to the latter an obvious utility in everyday life:

> As a word, *intelligence* is closely related to *intellect,* which is a comprehensive term for observing, understanding, thinking, remembering, and all ways of knowing and gaining knowledge. Intellectual activity yields knowledge of a situation Intelligent activity does this and something more. It is useful, it helps in solving a problem and reaching a goal. Counting, for example, is an intellectual activity and yields knowledge, but whether this knowledge is useful or not depends on the matter in hand Counting the chairs in your room and the guests you expect is an intelligent way of making sure you have enough chairs, but counting the letters on a page is scarcely an intelligent start toward learning a lesson. In common speech, then, *intelligence* means *intellect put to use.* It is the application of intellectual abilities in handling a situation or accomplishing any task.

The specialists in the construction and use of intelligence tests have been confident of the eventual value of their instruments for the diagnosis of vocational fitness. Terman (*609,* 17) predicted in 1916 that the time was not far distant when intelligence tests would become a recognized and widely used instrument for determining vocational fitness. He did not claim that tests were available that would tell exactly what one of hundreds of occupations a given individual is best fitted to pursue. But he predicted that when thousands of children who have been tested by the Binet Scale have been followed out into the industrial world, and their success in various occupations noted, one should know fairly definitely the vocational significance of any given degree of mental inferiority or superiority.

After twenty-five years this prediction has proved to be sound, although the evidence is somewhat clouded by the relatively great growth of tests for special abilities, personality, and temperamental characteristics. Only now, after the passage of nearly a generation, is it becoming possible to check measured intelligence against achievement in the world.

It appears from these brief remarks about concepts of intelligence that although they may create a presumption of utility for vocational purposes, the real answer will have to derive from an examination of the tests themselves. The previous discussion of the meaning of intelligence and of the origin of intelligence differences suggests three fundamental conditions that must be met if intelligence tests are to be used for a satisfactory classification of people and for evaluating their vocational fitness. These are: first, the intelligence test should comprise an *adequate sampling* of the pertinent behavior; second, the test should be standardized upon a proper sampling of the population; and third, some means should be found to allow for differences in opportunity.

THE INTELLIGENCE TEST AS A SAMPLING OF BEHAVIOR

The best known tests of intelligence comprise a varied battery of tasks that would seem to measure general, all-around competence. Both the individual and the group forms of such tests contain literally hundreds of different things to be done. The question has been raised many times, however, as to whether the tests as at present constructed *do* measure a sufficiently varied assortment of functions to conform to the definition.

Although Thorndike (*628*, *237*), as quoted earlier, has said that intelligence tests might draw upon anything for their material, actually "they have, in fact, greatly favored words, numbers, space-forms, pictures, neglecting three-dimensional objects and situations containing other human beings."

There have been several reasons for thus restricting intelligence-test material to symbols. First, the Binet-Simon tests were devised for measuring school children in order that they might be more properly adjusted to their work; hence it was natural to measure them by means of the symbols that are the tools with which they work. Even today the intelligence tests find their widest application in the field of education and their characteristics continue to reflect this specialized use. Second, these same symbols are far more convenient to handle in test form than concrete objects would be. They alone make possible the printed test blank. No less than a roomful of concrete objects could adequately replace the usual paper and pencil test. Third, there is the belief that it takes a higher grade of intellect to deal with symbols, abstractions, and general notions than with concrete objects and particular situations, so that a test which is to cover any considerable range of intelligence must be of the abstract sort throughout.

On the other hand, the unequal distribution of the power to deal with abstract symbols, together with indications of a similar inequality in the power to deal with mechanical things, and a suspected talent of some persons to deal with social situations, has led to the supposition that intelligence may be measured as though it were specialized in nature. Thorndike (*627*) has said that a perfect description and measurement of intelligence would involve testing the man's ability to think in all possible lines, but that for ordinary practical purposes it suffices to examine for three "intelligences," named *abstract intelligence, mechanical intelligence*, and *social intelligence*. By abstract intelligence he means the "ability to understand ideas and symbols, such as words, numbers, chemical or physical formulae, legal decisions, scientific laws and principles." Mechanical intelligence he defines as the "ability to

learn to understand and manage things and mechanisms such as a knife, gun, mowing machine, automobile, boat, lathe, piece of land, river, or storm." And social intelligence is the "ability to understand and manage men and women, boys and girls—to act wisely in human relations."

In addition to tests of abstract intelligence, tests of mechanical and social intelligence have been devised and standardized and are in use today. Among these may be mentioned the Minnesota Mechanical Ability Tests (*486*) and the Social Intelligence Tests of Moss, Hunt, and Omwake (*303*). That more can be done than has been done toward making an intelligence test of universal applicability is suggested by Thorndike's Intelligence Examination for High-School Graduates which contains an optional section on mechanical information for persons who know the farm and the workshop.

The foregoing statements make it appear that the commonly used intelligence tests do not adequately sample all kinds of reactions, and that one means of partially correcting for this inadequacy would be to use all three kinds of tests where a general evaluation of competence is needed. Short of this procedure, one should at least recognize the limitations of the abstract intelligence test and use caution in interpreting it, particularly when measuring for vocational fitness.

THE POPULATION SAMPLES FOR TEST STANDARDIZATION

The ideal intelligence test would be one that would not only sample every aspect of intelligence but would at the same time be free from the influence of racial traditions, language, geographical location, social and economic customs Much thought and labor have been expended in the effort to build such an instrument, but with little success. A conspicuous early example of this was the International Intelligence Test (*138*), employing no language and only those symbols which it was supposed would be universally understood. More recently Cattell (*99*) made a fresh attempt to build a culture-free intelligence test out of non-language symbols for objects of "common knowledge, such as the human body, footprints, trees, fire, smoke, and animals." The prospects of success seem no brighter today than they did two decades ago.

Even tests for English-speaking peoples, and for the culture of the United States, offer challenging problems of standardization and no test can be considered perfect in this respect. The earlier Stanford-Binet tests (*609*) were open to criticism because of a too heavily weighted sampling of children from high-level English-speaking families. Consequently the scores attained by the population at large were too low. The more recent revision (*610*) has been based upon a more adequate

sample, having care for due representation of different states, east, west, north, and south, for occupational groups such as skilled and unskilled labor, clerical, business and professional, and for rural and urban neighborhoods. As a consequence of this, and possibly of other factors as well, the general level of scores is higher for the revision than for the original test.

It is necessary, therefore, to know something about the standardization of a test, and the corrections that are needed in order that one may use it intelligently upon any given group of people. Those children who speak English but who live in homes where a foreign language is spoken constitute only one of the many problems for proper evaluation. The studies of Klineberg (*344*) and of Garth (*199*) on Indians show the effect of racial tradition upon intelligence score, and the report of Shimberg (*563*) suggests the effect of a rural or urban background upon intelligence-test performance. The newer intelligence tests, both the group and individual tests, are standardized upon better samplings of the population and at the same time their authors are more likely to advocate the limitation of their use to groups for which the standards are appropriate.

DOES THE TEST MAKE ALLOWANCE FOR DIFFERENCES IN OPPORTUNITY?

The question may again be raised as to how an intelligence test that so ostensibly measures in terms of learned reactions can be said to measure innate capacity. The answer is that with *equality or equivalence of opportunity* the differences that appear must result from some influence independent of these equivalent factors, namely, innate power. Equality or equivalence of opportunity means that environments must be equivalent, the home, the school, the playground, the library, and the church, or that such differences as there are in some respects will not influence the test score. Some control of the environment is presupposed in the use of all tests. Sometimes it is allowed for in the construction of the tests themselves. Thus, Binet, in the preparation of his original test material, attempted to employ only material so ubiquitous that no child except the lowest grade of the feeble-minded could have missed *the opportunity* to meet it and know it. He used postage stamps, small coins, numbers, and parts of the body. Sometimes the use of the test is restricted to those persons whose environments are known to be equivalent. The intelligence test used as a college entrance examination generally presupposes besides good health, a *satisfactory academic record in an accredited preparatory school.* Here, then, certain minimal environmental contacts are assured. Given these, the differ-

ences in test performance measure the degree to which the individual's innate capacity enabled him to avail himself of his opportunities. It is, unfortunately, impossible to insure perfect equality of opportunity in any case, because there are too many subtle influences at work, such as the varying incentive to intellectual effort. The only practical question can be: Do the differences matter? Does the environment of the rural child put him at a disadvantage, does a foreign-language-speaking parent put his child at a disadvantage, does the occupation of machinist put one at a disadvantage, does the occupation of nurse put one at a disadvantage, when tested with an instrument standardized as tests now are? The answer seems, in certain cases, to be yes, and in others no.

The conclusion to be drawn from these and the previous observations is not that the intelligence tests are for practical purposes worthless on all three counts. It is rather that the limitations of the tests, which are inherent in their construction and use, must be thoroughly understood by those who employ them. Intelligence tests are not the simple fool-proof devices that many persons expect them to be. Their effective use calls for understanding of their nature, training in the exact methods of administration, and a sufficient background of psychological knowledge to interpret scores properly.

THE USES OF THE INTELLIGENCE TEST IN VOCATIONAL ADJUSTMENT

The definition of intelligence leads one to expect that it would play an important part in vocational adjustment and the discussion of the intelligence test demonstrates its probable serviceability for predicting adjustment. Something should be said about the meaning of vocational adjustment at this point. It does not mean merely getting the maximal amount of output from the worker, for that can be accomplished for a short period at least along with a high degree of maladjustment. As the term is to be applied here to vocational problems, adjustment means *competent performance by a satisfied worker.* And neither achievement nor satisfaction should be overemphasized to the detriment of the other. The need for recognizing these two factors in vocational adjustment was long ago pointed out by Roundtree (*532*) and others, but those who practice vocational selection have been prone to neglect the second of the two.

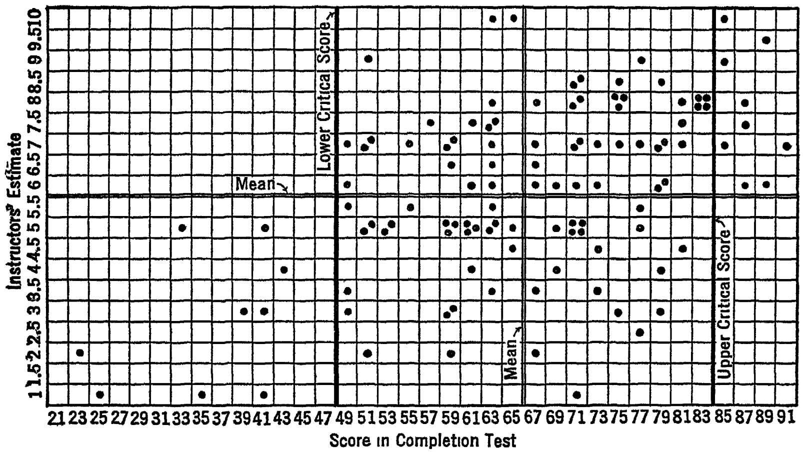
THE ELIMINATION OF THE UNFIT

A certain minimum of general capacity, or intelligence, is a prerequisite for successful adjustment in any occupation. There can be no

doubt about this in the mind of any thoughtful person if he will think of the extreme cases. The most important service that intelligence tests can render is to establish this minimal intelligence level for as many occupations as possible. The tests are most commonly used for this purpose both in education and in vocational selection and guidance. Success in high-school work demands a given minimal intelligence, and success in college work also demands a given minimal intelligence higher than the former. Tentative limits have been set in certain manual, clerical, and selling occupations. The implication in all these cases is that one who does not possess at least this amount of intelligence cannot perform the duties of the occupation or be satisfied in it.

FIGURE 61

CRITICAL SCORES FOR SUCCESS IN SCHOOL WORK *



* From L. L. Thurstone, "Mental Tests for College Entrance," *J Educ. Psychol*, 1919, *10*, 137.

The method of establishing such occupational "dead-lines" is illustrated in Figure 61 (*639*). This is a scatter diagram showing the relation between success in school work and score on the familiar Sentence Completion test. The vertical scale, consisting of twenty steps, represents degrees of success in school work measured in terms of a consensus of instructors; the horizontal scale indicates score in the test, and extends from 21 to 91 points of credit. Each dot on the chart represents one student. By locating a given individual on the horizontal scale his standing in the test will be known, and by locating his position on the vertical scale his standing in school will be known. Thus the poorest individual in the test (lower left corner of the chart) made a test score of 23 and stood in the next-to-the-poorest tenth of the student group. If one wished to raise the standard of the school

so that no student below the present average could be admitted, the dead-line would have to be placed at 84 (upper critical score). Such a dead-line would obviously be out of the question, since in eliminating the cases below the average almost all above the average would at the same time be excluded. A "critical score" might, however, be set at such a point that all students who get less than that score would be sure to be unsatisfactory (that is, below the mean). In the case illustrated the score would be 48. Even this dead-line would not perform a very useful service, since it would eliminate only about 20 per cent of those below the mean. Other critical scores might be tested out in this case, but the general distribution of the scores will suggest that the test does not provide suitable critical scores for the purpose.

This illustration demonstrates the fact that critical scores for the elimination of the unfit are not fixed in any absolute sense but may be varied from time to time according to the standards of performance to be maintained and according to the supply of applicants. Whether it be an educational institution, a business, or an industry, the dead-line may rise when applicants are plentiful and may be depressed when applicants are few.

Intelligence limits were set in a relatively crude fashion even before tests were employed, and independently of such tests now that they have come into general use. Competition and the necessity for satisfactory performance of duties will in time eliminate from any organization those who fail to come up to its standard of achievement. The functioning of such standards is clearly demonstrated in the study of mill-workers by Otis (*477*). A clerical test for the selection of an office force having proved of decided value, he devised a performance intelligence test for manual workers. He was confident that the tests did measure intelligence, and yet the correlation between standing in the test and performance on the job was just zero. In interpreting this zero coefficient he says that it was not possible to test such individuals as had failed to learn to weave or spin or be worth employing in some branch of the industry because they had been eliminated. These might have shown a lesser intelligence as a group. The further statement of Otis that intelligence is a very unimportant factor in efficiency in silk-mill work is undoubtedly true, although it should not cloud the fact that a certain minimum of intelligence is required even there, and that the use of a simple intelligence test in the selection of workers would prevent the employment of those below the required standard.

Bingham and Davis (*45*) furnish an instance of the same sort, but for the opposite extreme of intelligence. They measured the intelligence of 102 executives and correlated their scores with ratings of their success in the business world. The coefficient of correlation was —.10.

The authors noted that all the individuals who were tested were in the upper half of the population so far as intelligence is concerned, which suggested to them that at least this minimum of mental alertness as measured by an intelligence test is important for business success. The minimum had been automatically set and maintained in the ordinary course of business operations. They make the following comments (*45*, 3):

In the world of business, success is first of all a matter of getting things done. Ability to persuade and control people is an outstanding asset. Effectiveness within an organization demands such traits as dependability, coöperativeness, energy, promptness of decision If traits like these are present in high degree, a man may make a notable business success even though his mental alertness test rating on the Army Scale is only B or C. Intelligence there must be above a certain minimum. But this minimum is, perhaps, not so high as is often supposed.

This quotation suggests a very important characteristic of the critical-score method of selection, namely, that it eliminates the unfit, but does not guarantee the success of the fit. What the critical score really means is that an individual will have the requisite intelligence for the occupation, but having that, his success will depend upon his possession of the other traits essential for success. A few of the traits that are needed for success in business are mentioned in the quotation but there are many others. Even in the case of the college student this limitation of the use of the critical score holds. The correlation between intelligence-test score and success in college, which runs no higher than .60, gives some indication of the importance of the non-intellectual factors. Among these are physical health and stamina, extracurricular activities, need to be self-supporting, and interest and incentive for college work.

Pond and Bills (*508*) furnish an excellent illustration of the use of the critical intelligence-test score in the selection of clerical workers where satisfactory minima for different grades of work were set. The test was a modification of the Army Intelligence examination. Table 38 is adapted from their data, and shows the percentage of the various grades of workers in the plant who fell within the different score groups. Within the *A* and *B* class, which is the lowest grade, 8 per cent fell within the 0-40 range, whereas 1 per cent had a score of 141 or better. They set the critical score for grades *C* and *D* at 80. By doing so they would eliminate 54 per cent of those who would be below the desired grade, but at the same time they would eliminate just 53 per cent of those good enough for grades *C* and *D* or higher. It should be noted also that they would fail to eliminate the 46 per cent who would not be good enough for grades *C* and *D* but who nevertheless made scores

above the dead-line of 80. Where the number of available candidates is sufficiently large, the probable loss of so many potentially satisfactory workers in order to eliminate a given percentage of the unsatisfactory workers might be justified. The critical score for grades *E* and *F* was set at 100. The reader may compute for himself the probable loss of poor and good candidates in this instance, and for any other dead-lines that seem feasible to him.

TABLE 38

CRITICAL SCORES FOR CLERICAL WORKERS *

Approximate Percentage of Each Job Group with a Given Test Score

Job Group	0—40	41—60	61—80	81—100	101—120	121—140	141—
G and *H*..	0	0	0	7	37	43	13
E and *F*..	4	8	9	22	33	16	8
C and *D*.	2	9	21	26	28	11	3
A and *B*..	8	19	27	25	15	5	1

* Adapted from M. Pond and M A Bills, "Intelligence and Clerical Jobs," *J. Person Res.*, 1933-34, *12*, 44.

Burr (*66*) has attempted to find suitable occupations for mentally deficient individuals by setting the minimal intelligent levels necessary to do various kinds of simple work. She has disclosed unsuspected work opportunities for low mentalities by using the critical-score method with the objective of selection instead of elimination.

Beckham (*32*) has compiled the data from a number of studies showing the minimal intelligence, in terms of mental age, necessary for profitable pursuit of a variety of occupations. They are presented here in condensed form:

Mental Age 5

Wash dishes, sandpaper furniture, scrub and polish floors, feed and fold from mangle, simple domestic work, brush makers' assistant, handle cinders and garbage, make nets, cut rags in accurate strips.

Mental Age 6

Mow lawn, kitchen scullion, mix cement, handle freight, brush making, simple laundry work, assist brick mason.

Mental Age 7

Rough painting, simple shoe repairing, drive two-horse team, plow, blacksmith assistant, cane chair, make brooms, simple carpentery, domestic work.

Mental Age 8

Handle coal and ashes, clean tubes, pitch and load hay, general barn work, paint outside and interior flat work, cut hair and shave, shingle and set glass, make wooden toys, make nets, garden work, repair mattresses.

Mental Age 9

Entire process of broom making, foot-power printing press, block paper into pads, repair furniture, paint toys, higher processes of shoe repairing, harvest vegetables and fruits, mattress and pillow making, learn to play an alto horn and manipulate drums, fancy brush making.

Mental Age 10

Setting and sorting type, sign painting, electrician's assistant, steamfitter's assistant, form making for cement and floors, shellacking and varnishing, learn bass horn and cornet, laundry work (detailed), garden work (detailed), farm work and dairying, carrying mail.

Mental Age 11 and 12

Competent janitors, stock keeping, store keeping (small), labeling and checking, green house attendant, lawn (caretaker).

Two other age groups, namely 13 and 14, taken from Burr (*66*) will complete the range from very low grade to normal intelligence. They are:

Mental Age 12 to 13

Sewing on labels at high speed; machine operating for straw and other millinery, for window shades, garters, powder-puffs, etc.

Mental Age 13 to 14

Assembling of parts requiring some judgment, machine operating in sewing straight seams, bindings, etc, where threading and adjusting machines are necessary; completion of an entire garment.

The most notable collection of data on the establishment of intelligence limits for various occupations is found in the intelligence and personnel records obtained by the United States Army during the first World War. These have been amplified and corrected somewhat by Fryer (*193*) and appear in his table of occupational intelligence standards which is reproduced in Table 39. The maximal and minimal scores represent the limits within which success in the occupation can be expected. These limits do not include, however, the whole range of intelligence that is found within the occupation. Approximately the poorest and the best quarter have been eliminated, on the assumption that

TABLE 39

CRITICAL INTELLIGENCE SCORES FOR OCCUPATIONS *

Intelligence Group	*Score Average*	*Score Range*	*Occupation*
A	161	110–183	Engineer (civil and mechanical)
	152	124–185	Clergyman
	137	103–155	Accountant
B	127	107–164	Physician
	122	97–148	Teacher (public schools)
	119	94–139	Chemist
	114	84–139	Draftsman
	111	99–163	Y.M.C A. secretary
	110	80–128	Dentist
	109	81–137	Executive (minor)
C + ...	103	73–124	Stenographer and typist
	101	77–127	Bookkeeper
	99	78–126	Nurse
	96	74–121	Clerk (office)
	91	69–115	Clerk (railroad)
	86	59–107	Photographer
	85	57–110	Telegrapher and radio operator
	83	64–106	Conductor (railroad)
	82	57–108	Musician (band)
	81	59–106	Artist (sign letterer)
	81	60–106	Clerk (postal)
	81	57–109	Electrician
	80	62–114	Foreman (construction)
	80	56–105	Clerk (stock)
	78	54–102	Clerk (receiving and shipping)
	78	61–106	Druggist
	77	59–107	Foreman (factory)
	75	56–105	Graphotype operator
C	74	53–91	Engineer (locomotive)
	72	54–99	Farrier
	70	46–95	Telephone operator
	70	44–94	Stock checker
	69	49–93	Carpenter (ship)
	69	48–94	Handyman (general mechanic)
	69	46–90	Policeman and detective
	68	51–97	Auto assembler
	68	47–89	Engineman (marine)
	68	42–86	Riveter (hand)
	67	50–92	Toolmaker
	66	45–92	Auto engine mechanic
	66	45–91	Laundryman
	66	49–86	Gunsmith
	66	44–88	Plumber
	66	44–88	Pipefitter
	65	44–91	Lathe hand (production)
	65	43–91	Auto mechanic (general)
	65	43–91	Chauffeur
	65	42–89	Tailor

* From D Fryer, "Occupational Intelligence Standards," *Sch and Soc*, 1922, *16*, 273-278.

TABLE 39 (*Continued*)

Intelligence Group	*Score Average*	*Score Range*	*Occupation*
	65	44–88	Carpenter (bridge)
	64	43–88	Lineman
	63	40–89	Machinist (general)
	63	46–88	Motor cyclist
	63	41–86	Brakeman (railroad)
	62	31–94	Actor (vaudeville)
	61	40–85	Butcher
	61	44–84	Fireman (locomotive)
	61	39–82	Blacksmith (general)
	60	38–94	Shop mechanic (railroad)
	60	36–93	Printer
	60	40–84	Carpenter (general)
	59	40–87	Baker
	59	39–83	Mine drill runner
	59	38–81	Painter
	58	37–85	Concrete worker
	58	40–83	Farmer
	58	37–83	Auto truck chauffeur
	58	37–82	Bricklayer
	57	41–81	Caterer
	57	39–71	Horse trainer
	56	38–76	Cobbler
	55	35–81	Engineman (stationary)
	55	34–78	Barber
	55	35–77	Horse hostler
	52	38–96	Salesclerk
	52	33–74	Horseshoer
	51	31–79	Storekeeper (factory)
	51	26–77	Airplane worker
	51	31–74	Boilermaker
	50	33–75	Rigger
	50	30–72	Teamster
	49	40–71	Miner (general)
	48	21–89	Station agent (general)
C — ……	40	19–67	Hospital attendant
	40	19–60	Mason
	35	18–62	Lumberman
	35	19–57	Shoemaker
	32	16–59	Sailor
	31	20–62	Structural steel worker
	31	19–60	Canvas worker
	30	16–41	Leather worker
	27	19–63	Fireman (stationary)
	27	17–57	Cook
	26	18–60	Textile worker
	22	16–46	Sheet-metal worker
	21	13–47	Laborer (construction)
D ……..	20	15–51	Fisherman

neither group could successfully adjust itself to the occupation. A casual examination of the table will show how crude the guidance will be that is based solely or even mainly on intelligence status. Grade C, for example, which represents the average intelligence of the population, covers fifty-four occupations in the table, and that is in no sense a complete catalogue of occupations. Some determinant other than intelligence would be required to discover which of the fifty-four occupations a C person should enter. The same is true of the other five intelligence grades. A fourfold classification is as much as can be hoped for on this basis at present, such as professional, skilled, semi-skilled, and unskilled (labor).

A very suggestive classification might be built upon the nature of the materials and the processes with which the worker has to deal. Thus it could be inferred from this chart that an individual with an intelligence score of 86 works well with raw materials and domesticated animals. An intelligence of 100 can handle materials in a semi-finished state and can use simple tools, but cannot deal effectively with symbols. Working with abstract symbols of a simple sort requires an average intelligence of 115. Individuals in the 120 class can handle complex symbols and can deal with the simpler relations with other human beings. But those dealing chiefly with other individuals in the relation of foreman, executive, officer, and in the professions require the exceptional intelligence indicated by an average score of 130.

When occupational critical scores have become more refined and free from error, it may be possible to predict fitness more specifically than is safe under the present circumstances. One might sometimes be able to say to an applicant who wants to become an electrician, and who has an intelligence score of 57, that he could do the work, but would always stand among the poorest of this group; to another with a score of about 80 that he could not expect to be more than an average electrician; to still another with a score of about 110 that he has the ability to stand near the top of his occupational group.

CRITICAL SCORES IN EDUCATION

Dead-lines of a crude sort have been set for the various levels of the elementary and high school. For instance, Terman (*608*) made the following predictions concerning school achievement:

1. A child of 60 IQ will never be able to do good work above the third or fourth grade.
2. A child of 70 IQ will be able to attain fifth grade and may do average work there.
3. A child of 80 IQ will be able to do average work in the seventh grade.

4. A child of 90 IQ can progress through eight grades, but with the expectation of a half or full year retardation. Persistence may carry such a person through high school but with difficulty.

Cobb (*106*) gives the minimal Army Alpha scores necessary for attaining certain levels of achievement in high school. These are as follows, with their equivalent in terms of Mental Age and IQ:

	Alpha	*MA*	*IQ*
Minimal Intelligence for Entrance into High School	65	14 0	90
Minimal Intelligence for Graduation from High School	85	15 5	97
Minimal Intelligence for Satisfactory Work in High School......	105	16 6	104

In college work, the following predictions have been made in terms of the Thorndike Intelligence Examination for High-School Graduates. A student with a score in this test of:

50 or less—should not be admitted.
50–60—should be admitted only if of extraordinary zeal or has suffered very great educational handicaps
60–70—may be admitted if sufficiently in earnest and otherwise desirable.
70–85—intellect sufficient to obtain a college degree
85–95—intellect enough to do collegiate and professional work with distinction.
95 or more—worth admitting in entire disregard of technical deficiencies.

The significance of these sets of estimates does not reside in the particular tests used nor in the size of the IQ's or test scores but in the fact that competent investigators consider it feasible to set such limits of probable achievement on the basis of intelligence measurement.

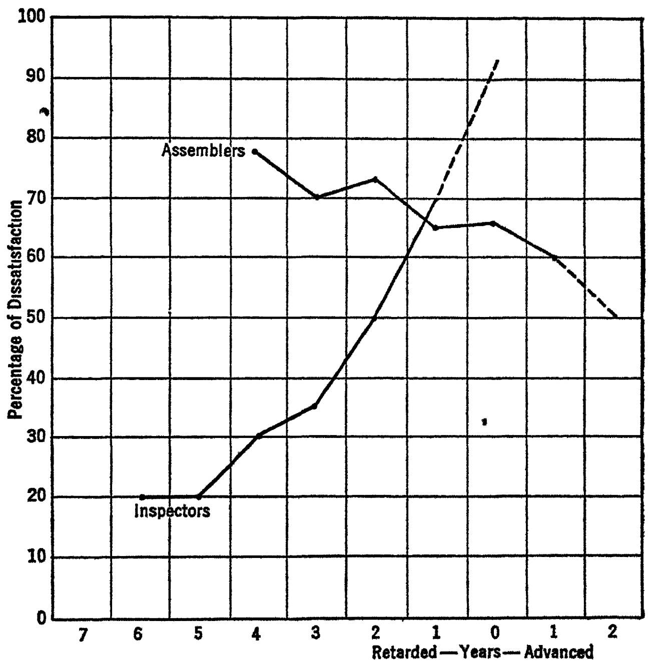
THE ELIMINATION OF THE TOO HIGHLY ENDOWED

The need for setting an upper limit of intelligence for occupational success will surely seem less obvious than the need for a lower limit. If one is intelligent enough to do a job at all a higher degree of intelligence should not make him less fit. Indeed, it will not, in so far as ability to achieve is concerned, but it is necessary to recall that proper adjustment means satisfaction as well as high output. The person who is vocationally unsuccessful may be one who "is attempting to succeed in an occupation demanding greater intelligence than his"; or one who "is in an occupation which fails to make sufficient demands upon his intellectual capacity to keep him interested and at work." There are many so-called monotonous positions that intelligent persons find irksome and unsatisfying. Consequently, it seems that in such cases a high degree of intelligence is not only not required but may be a positive handicap to endurance of the steady routine work. Persons of low mentality may succeed in just such work.

Scott and Hayes (*545*) obtained for a number of occupations both an indication of the intelligence of the workers and their satisfaction in their work. Intelligence was inferred from the grade reached in school, and satisfaction was gauged by interviewing the worker. The relationship between these two measures in the case of two occupational groups is shown in Figure 62. The vertical scale is in terms of the per-

FIGURE 62

RELATION BETWEEN INTELLIGENCE AND SATISFACTION *



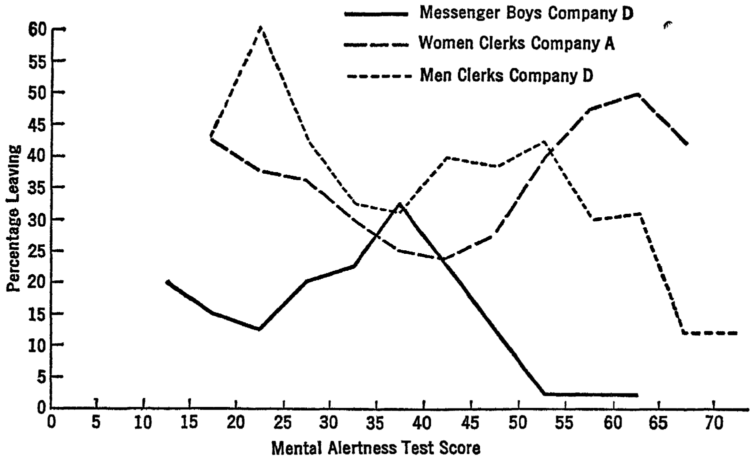
* Adapted from W D Scott and M H S Hayes, *Science and Common Sense in Working with Men* (New York, The Ronald Press Co , 1921), p. 73

centage of persons dissatisfied with their job, and desiring change. The scale ranges from zero, or no cases of dissatisfaction, to 100, or dissatisfaction of all the workers. The horizontal scale indicates the number of years retarded or advanced in school, with the zero point representing the normal school status. It should be noted that in the case of the inspectors the greater the mental capacity the greater the dissatisfaction. The work in this department is reported as simple, "fool-proof," repetitive, and monotonous. Only those of relatively low intelligence could find satisfaction in this work. It is interesting that

in the inspection department were found both the highest percentage of satisfaction and the highest percentage of dissatisfaction. This means that in this department there is opportunity to secure, through the right adjustment of mental ability to the job, the highest degree of stability; and there is also the danger of producing, through maladjustments, the greatest instability. "From the point of view of job-satisfaction, this single occupation is both the best and the worst in the plant—depending on the extent to which selection and assignment of workers is based on a consideration of the mental alertness of the applicant."

FIGURE 63

RELATION BETWEEN INTELLIGENCE AND TURNOVER *



* Adapted from W D Scott, "Turnover and Mental Alertness Test Scores," *Bull L*, 1920, No 2, and "Mental Alertness of Messengei and Office Boys," *Bull M A*, No 10

The curve for the assemblers takes just the opposite course. The most dissatisfied are the least intelligent and the most satisfied are the most intelligent. The assembling operation required a high degree of manipulative skill and a fair degree of judgment. The greatest degree of retardation found in this occupation was four years, compared with six years in the other. This probably means that mentalities as low as six years of retardation were not only dissatisfied but could not even survive in this occupation.

Scott (*543*) reported somewhat similar results for office workers, where the percentage leaving the company was computed for various degrees of mental alertness (intelligence). Although reasons for leaving are not specified, they are reducible to poor adjustment. Figure 63, compiled from the Scott reports, shows the relationship between percentage leaving and mental alertness for a group of men clerks and a

group of messenger boys in one company, and a group of women clerks in another company. In the case of the messenger boys, the highest percentage leaving is found in the intermediate alertness level, whereas the two extremes are more stable, with the greatest stability at the high alertness level. Scott attributed these findings to the fact that the more alert messenger boys are recognized as material for higher positions and are, therefore, satisfied. The less alert boys are capable of no work higher than messenger service and are happy in it. The intermediate group is presumably too good for permanent messenger service and yet not likely to compete successfully with the more alert boys, hence they are dissatisfied. The men and women clerks, on the contrary, show the greatest stability in the middle range of intelligence and the least at the extremes.

TABLE 40

HIGH AND LOW CRITICAL INTELLIGENCE LEVELS *

Grade of Work	*Original*		*After 30 Months*	
	Number cases	Test-score median	Number cases	Test-score median
A Low	16	85.0	7	67.5
B	15	77.5	6	80.0
C	24	105.0	11	95.0
D	56	103.5	26	111.0
E High	22	118.5	13	123.0

* Adapted from M A Bills, "Relation of Mental Alertness Test Score to Positions and Permanency in Company," *J Appl Psychol*, 1923, *7*, 154-156

A study by Bills (*43*) furnishes indirect evidence of the working of both an upper and a lower critical score. She selected 133 clerical workers engaged in work of five different grades of difficulty and followed the group through a period of two and one half years. She assumed that persons making low intelligence-test scores would be unable to handle high-grade work and would leave, and that those with high scores would be dissatisfied with low-grade work and would leave. As a consequence, the level of the high-grade group should rise through the loss of the low-grade individuals, and the level of the low-grade group should fall through the loss of the more intelligent individuals. Her supposition was supported by the data, a few of which are given in Table 40. The score for Group A fell from 85.0 to 67.5 and that for Group E rose from 118.5 to 123.0. The trends are not so clear in the intermediate groups.

THE PREDICTION OF SUCCESS

It is an easier task to eliminate the unfit than to find the specially fit. If an individual lacks one component that is essential for a job, he will be unfit for the job, whether that component be intelligence or any other. If, however, he has intelligence above the amount needed, he may or may not succeed, depending upon the presence and the influence of the other contributing factors.

It might be presumed that there are some occupations where intelligence is such a vital factor that the correlation between achievement and intelligence will be high enough for accurate prediction of success on the basis of intelligence score alone, and where one can say that the greater the intelligence the greater the success will be. Some indication of the possibilities may be gained from a study of the relation between intelligence-test record and performance in college work. There, if anywhere, intelligence should play a major rôle. The highest correlation that has been obtained in this case is about +.60 (*198*, 51-54). It should be remembered that in every college the intelligence dead-line has already been set rather high through entrance requirements, and that this correlation is obtained only from those who are permitted to enter. It has been predicted that if there were no restrictions upon entrance, the correlation between intelligence score and achievement would be as high as + 80. It is scarcely to be expected that any branch of vocational work will show a higher correlation than this.

To predict the degree of success of *any given individual* on the basis of a coefficient of correlation requires that the correlation be higher than any that have been obtained thus far. This will be evident when the meaning of a coefficient in terms of predicting the individual case is clearly understood. A rough estimate of the "forecasting efficiency" (*115*) of any given coefficient may be obtained from the formula:

$$E = 1 - \sqrt{1 - r^2}$$

in which E is the "forecasting efficiency" or the percentage of efficiency of prediction, and r is the coefficient expressing the relationship between two tests or between a test and a criterion. A specific example will make the interpretation clear. Suppose that the correlation between an intelligence test and success in college measured in grades is +.60, and one wishes to predict the probable success of a certain individual in college from his intelligence-test score. E would in that case be .20, which would mean that the prediction would have an efficiency of 20 per cent. According to Garrett (*197*, 344-346), for coefficients less than +.80 the errors are so large that predictions are little better than a

"guess"; and in order to estimate individual scores accurately, the correlation should not be less than .90.

Such is the unfavorable state of affairs for the guidance of an individual on the basis of a test score. When, however, it is a matter of selection of a number of candidates and one is interested in the "long run" of his choices rather than in individuals, the test may be of real service. For any correlation above zero does mean a positive relationship and that is better than no selective device at all. If there is a correlation of +.50 between intelligence-test score and success in college, one would do far better to select the more intelligent than to neglect intelligence.

LONG-TERM PREDICTION

When long-term prediction is called for, as in guiding a young person into a career upon the basis of an intelligence test, the additional factor of the stability of intelligence status must be taken into account. If the correlation between intelligence and success in secretarial work happened to be +.50, how safely could one predict the eventual success in that occupation of children whose intelligence is measured at the age of six years? Certainly the correlation would not be increased by widening the interval between date of prediction and period of achievement. It is to be expected that it would be decreased somewhat, if only because of the normal degree of variation in the IQ over a period of years, which is estimated to be on the average about 5 IQ points. The studies of long-term prediction which have been made thus far have yielded rather discouraging results to the enthusiastic advocates of vocational guidance. Notable among these studies is the investigation of Thorndike (*635*) and associates covering an interval of eight or more years between test and follow-up. This and similar studies will be discussed in the next chapter so that no data will be presented here. Low as the correlations were, and they were very low in the light of the size needed for prediction, Thorndike believes that "employers certainly can profit greatly by using tests of intelligence, clerical capacity, and mechanical adroitness in the selection of employees.... The test scores will be much better than prejudices and superstitions." (*635*, 118)

INTELLIGENCE AS AN INDICATOR OF CHARACTER

The importance which attaches to such non-intellectual traits as are usually included in the term "character" led to the search for such a positive relationship between that and intelligence as would make the presence of the latter an indicator of the presence of the former. This was particularly true in the early days of testing when the difficulties

inherent in testing for character qualities seemed insurmountable. The correlations, however, have been discouragingly small.

Nevertheless, it must be true that, in the long run, desirable traits of character and high intelligence do go together. Socially acceptable behavior depends, as Terman (*609*, 11) has said, upon two sets of conditions: namely, the capacity to foresee the consequences of one's acts, and the willingness and the power to restrain oneself from doing what will have evil consequences. Intelligence is, then, one of the indispensable determiners of acceptable behavior. Thorndike (*627*) puts the matter dramatically in the following passage:

> The abler persons in the long run are the more clean, decent, just, and kind. To this feature of human nature which has tied good-will toward men to ability, a large proportion of the blessings which the common man enjoys today are due. The brains and ability of the world have been, and still are, working for the profit of others. If Pasteur had been of mean and brutal nature, he could have kept his first discoveries as a trade secret, extorted a fortune in fees, and lived in sensuous idleness, leaving the world without his still more important later work. Flexner or Carrell could poison their enemies or rivals except for the tradition of justice and generosity which the positive correlation between intelligence and morality has made a part of scientific work, and which their own natures gladly maintain.

Thorndike (*626*) rests heavily upon the positive correlation between intellect and character in his applications of psychology to economics when he says that by electing the most intelligent men to public office, the people stand a good chance of getting thereby the most charitable, kindly, considerate, and public-spirited leaders. Although such a relationship may give one confidence in human nature, it is far from furnishing the basis for prediction of individual character from individual intelligence. The researches that have been reported in this field suggest that a correlation of +.40 is the best that can be expected (*102*). A coefficient of this size allows for the numerous exceptions that will come to the mind of the reader—those cases where men of high intelligence have demonstrated their cruelty, dishonesty, selfishness, and immorality.

16

The Rôle of Special Capacities and Abilities in Adjustment

Intelligence is presumed to be a general *native* capacity influenced by, but not determined by any environmental forces. Education might have been contrasted with it as general *acquired* proficiency. A very similar distinction will need to be made in the case of special capacities which are to be contrasted with abilities, the former being the native potentiality and the latter being the acquired proficiency. Woodworth (*715*, 55-57) has said that possession of the ability to do a certain thing amounts to saying that one *can do* it. He can do it without further development or training. "The only direct evidence of ability is actual performance." To say that an individual has the capacity to do something amounts to saying that he *can learn* to do it. "Evidence for capacity—is bound to be indirect." Both capacity and ability need to be measured in adjusting the individual, and in such measurement the distinction between them must be kept clearly in mind. *Ability* to typewrite can be measured directly in terms of typewriting performance. How fast and how accurately can a person write? But one cannot measure *capacity* to typewrite in that fashion, since there might conceivably be nearly zero ability in the absence of training but in the presence of a high capacity to learn. In what terms, then, can typing capacity be measured?

WHAT ARE THE SPECIAL NATIVE CAPACITIES?

It will be observed that in the foregoing statement the functions that have been referred to, such as typing, are not the capacities or traits with which the psychologist is concerned in his analysis of mental organization. The latter are the ultimate unitary functions, such as number capacity, language capacity, and the capacity to deal with spatial relations, whereas the former are jobs or tasks in business, in industry, in the professions, and in everyday life. These are not in any

sense irreducible units of function, but on the contrary are certainly extremely complex performances. Musical capacity, for instance, is a complex of many simpler special capacities such as pitch discrimination, intensity discrimination, and sense of consonance. Nevertheless, people do differ in musical capacity, swimming capacity, mathematical capacity, artistic capacity, bookkeeping capacity, stenographic capacity, as well as in ability in these functions. It is the difference among people in their potential power that the vocational psychologist is frequently called upon to measure.

It may sometime be possible to analyze these complex occupational functions into the simpler and more unitary traits. The most notable effort toward an analysis of vocations into their fundamental unitary traits is that of Kelley (*335*). By a statistical procedure too elaborate to be described here, he arrived at a tentative list of the traits necessary for proper functioning in a great variety of occupations. Moreover, he rated these traits according to their relative vocational importance. These are, in the order of importance: physical strength; verbal ability; a social trait; numerical ability; an abstract intelligence trait; a leadership, dominance, or drive factor; a memory trait; a religious trait; a motor trait; a general factor; special acuities; an interest factor; a spatial factor.

If this should turn out to be a complete inventory of the components of mental organization, it would only be necessary to devise a test for each component, and to determine its relative importance for each specific vocation. With such a limited battery of measuring devices, the work of the vocational counselor would be greatly simplified. Inadequate as the inventory is at present it points the way toward the ultimate goal of vocational psychology.

Other attempts have been made to derive factors within the more limited field of the motor skills. Langdon (*360*) worked with scores on a large variety of motor tests such as threading beads without the aid of the eyes, tying knots, screwing nuts on bolts, placing matches in a box, placing rings on a rod, and tapping. Using the Spearman technique of factor analysis (Tetrad differences) he isolated a general factor which was not intelligence, but which could be best described as dexterity. Success in any particular test, however, seemed to be due to a special factor peculiar to that test.

Cox (*118*, 178-242) also applied the same technique to discover the underlying factors in three series of operations calling for mental ability, mechanical ability, and manual ability. He found a general factor, Spearman's *G*, underlying all the operations; a mechanical factor of more restricted range effective in the mechanical ability tests; a routine manual factor in the manual tests; and two other factors less

easily identified. In addition there were special factors peculiar to each operation and playing a relatively large part, particularly in the manual tasks.

Seashore, Buxton, and McCollom (*548*) carried out a factor analysis of twenty-one tasks employing motor skills, using the Thurstone technique (*640*). Among the tests were several forms of reaction time, tapping, steadiness, eye-hand coordination of movements, and the handling of spatial relations. They derived six factors which they named from an inspection of the tests that carried the greatest weight in each. The six are speed of reaction; restricted oscillation of hand and finger in one plane; oscillation of forearm and hand in two planes; steadiness; manipulation of spatial relations; and a group of residual factors not identifiable.

The influence of this statistical mode of attack upon the analysis of complex functions can be seen in certain of the methods of measuring special capacities soon to be described. Until these techniques become more adaptable to the solution of practical problems, the cruder and more rule-of-thumb methods will continue to be the instruments for vocational selection and guidance.

THE MEASUREMENT OF SPECIAL ABILITIES

Ability is what one can do without further training, hence the measurement of ability consists in finding what one can do. Measurement of what one can do in the way of typing consists in the preparation of a proper sample of typing work, and in the provision of some standard means of evaluating or scoring the sample to see if it meets the requirements of speed, accuracy, and neatness. The measuring process, however, is not always so simple as that. If one wished to measure ability as a butcher it might not be convenient to have at hand a steer or a lamb to be cut up; or if one wished to measure ability as a blacksmith it might not be feasible to have anvil, forge, and the other equipment necessary to make a horseshoe. Moreover, the product would not be so easy to score as in the case of typewriting where the machine eliminates many variables that occur in hand work.

In the great bulk of ability measurements, convenience has dictated the use of pencil and paper tests. This technique has been favored too from the fact that most of the abilities measured are those learned in school where written tests are the normal means of measurement. In some cases, particularly in the trades, the spoken answer is substituted for the written one. The important point is that question and answer tests measure knowledge about a task and not skill in the performance of the task. Whenever questions are substituted for the actual sample

TABLE 41

DIFFERENTIATING POWER OF TRADE QUESTIONS *

	Question									
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Novice	0	1	0	1	2	0	0	1	1	0
Apprentice	17	14	8	12	8	10	5	4	7	0
Journeyman	18	15	17	16	16	14	15	13	12	6
Expert	19	18	19	17	19	18	18	17	16	16

* Adapted from J C Chapman, *Trade Tests* (New York, Henry Holt and Co, 1921), p 98.

performance, some means must be found for determining the significance of the questions.

The procedure employed in the preparation of trade-test questions for use in the army during the first World War will illustrate the method. The essential requirement is that there be available a group of workers in the trade whose abilities are known and among whom a wide range of abilities is represented. When the trade is well organized it may be possible to accept a trade classification of proficiency such as apprentice, journeymen, or expert. If there is added to these three a class of novices, there will be four grades of known ability. Where trade status is not known it may be necessary to resort to opinions of acquaintances, supervisors, or employers. Such a group whose abilities are known can constitute the criterion against which the questions are to be tested. A good set of trade questions should give differential scores for the various ability levels.

In the preparation of the Army Trade Tests, as described by Chapman (*101*), the criterion groups consisted of eighty persons, twenty in each of the four grades of proficiency named above. A long list of questions was submitted to them and only those were finally retained that could be answered by one or more of the grades but not by all four of them. Table 41 shows the number of correct responses by the criterion group to the twenty questions that were finally chosen in one instance. By glancing down the columns, one can discover the differentiating power of any question. Thus, Question 1 was answered correctly by none of the novices, by seventeen of the apprentices, by eighteen of the journeymen, and by nineteen of the experts. The question will distinguish a novice from persons with training, but will not discriminate among the grades of training. Question 10 serves fairly well to distinguish an expert from the other trade groups, since no novice or ap-

TABLE 41—(*Continued*)

DIFFERENTIATING POWER OF TRADE QUESTIONS

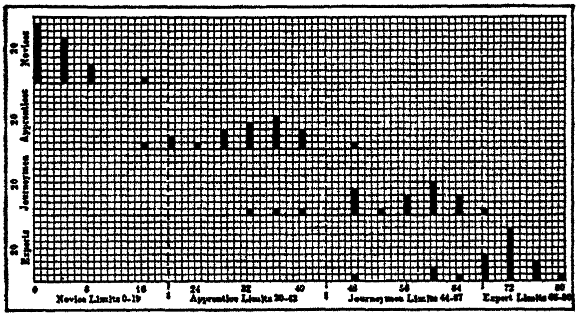
	Question									
	11	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*
Novice	2	1	0	1	1	1	1	0	1	2
Apprentice	5	4	1	3	16	7	16	2	10	15
Journeyman	12	12	8	7	16	11	16	14	16	16
Expert	18	17	14	14	19	16	18	19	18	17

prentice could answer it, only six journeymen could answer it, whereas sixteen experts could do so.

The whole set of twenty questions, some good for one purpose and some good for another, should differentiate the four groups. How well it does so will appear from Figure 64 which gives the distribution of correct answers for each criterion group separately. The scale of scores

FIGURE 64

DISTRIBUTION OF SCORES ON A TRADE TEST *



* From J. C. Chapman, *Trade Tests* (New York, Henry Holt and Co , 1921), p. 106.

is shown along the base line, each question getting a score of four points. Each small square on the chart represents one person. Thus nine novices answered none of the questions, seven answered four, three answered eight, and one answered sixteen. The critical scores shown by the dotted lines were set arbitrarily and might have been located elsewhere. If the four groups of twenty men each can be accepted as proper samples, then one can say that in the long run the critical score of

19 will prevent any novice from being mistaken for an apprentice, but 5 per cent of the time (one out of twenty cases in the sample) apprentices will be rated as novices. The reader should figure out for himself the differentiating value for the other criterion groups, and also try out other critical scores in a similar fashion.

The two most troublesome sources of error in using a set of questions, namely the substitution of knowledge for skill, and the use of inadequate or misleading questions, are forestalled by the procedure described since the differentiating power is empirically determined. This is essentially the technique employed in the construction of Trade Questions for the United States Employment Service (*580*, 30-48), where sets of questions have been standardized for 126 different jobs up to 1940, and where they are in daily use.

THE MEASUREMENT OF SPECIAL CAPACITIES

There are two contrasting views current in psychological theory concerning capacity. One is that there are no specialized capacities, that two individuals of the same intelligence level, and independent of training, can do equally well anything to which they may "turn their hands." The other view is that, in addition to a certain degree of intelligence, each person is endowed with special capacities of one sort or another. The former would certainly be the simpler point of view from which to construct a vocational psychology, since a good instrument for measuring general capacity would be all that the practitioner would require. Both points of view get some support from a casual survey of vocational tests, for although they are used for measuring all sorts of specialized vocational activities, they bear a striking resemblance to the components of the general intelligence examination, both in their form and in their content.

Careful study of the problem almost forces the opinion that persons are so specially endowed as to make them capable of greater proficiency in one line of work than in others. Even if a person of high intelligence will, in the long run, do everything better than one of low intelligence, he will do some things better than others; and of two persons of equal intellectual capacity one may do certain specialized activities better than the other. The theoretical discussion of general and special capacity has had relatively little influence upon practical measurement methods, for in vocational psychology one is likely to see only the immediate task, to select a competent person for training in clerical work, or to select a clerical worker for a particular job.

The most serious problem to be met in the measurement of special capacities, as they have been defined, resides in the fact that the

measurement must be indirect Potential power must be tapped rather than acquired proficiency The situation is similar to the one encountered in the task of evaluating intelligence as native endowment, independent of environmental influences. In that case intelligence differences are inferred on the assumption that the environmental influences are made equivalent. Difficult as it is to support that assumption in the case of general capacity, it is more so in the practical measurement of special native vocational fitness. The various ways in which the difficulty has been and is being met will be examined.

THE EMPIRICAL METHOD

The method developed mainly by American psychologists and most commonly used by them has been variously named the empirical method, the correlation method, the trial-and-error method, and the "blind leading the blind" method. Each of these names suggests one or another characteristic of the technique, but the first will be employed here as the most descriptive and the most dignified.

The essential fact about the method is that it does not resort to a deliberate sampling of the functions called for in the job, but it aims to discover, by empirically testing out a great variety of functions, which ones are essential for success in the occupation. Since the prospective tests are not selected on the basis of resemblance to the work in question, their value must be determined by checking performance in the test against performance in the occupation. There must be available, therefore, a criterion group, or a group of people who have had a certain amount of experience and who have attained various degrees of proficiency ranging from very high to very low. In the cases where there turns out to be a close relationship between score in the test and standing in the occupation, the test is considered a good one. Other tests which do not show a sufficiently close relationship are discarded.

EXPERIENCE OR TRAINING A COMPLICATING FACTOR

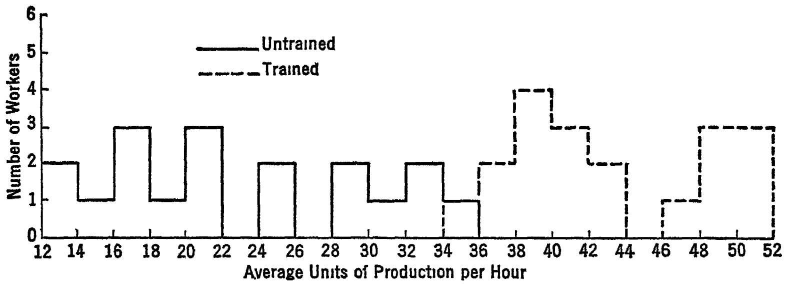
Tests derived in this way are frequently treated as measures of native capacity in spite of the fact that they have been standardized against persons with varying amounts of experience.

The assumption that makes this procedure seem acceptable is that, since the functions tested do not duplicate the actual work, they will have been changed little or not at all by the special training. In actual practice, however, the tests are not selected entirely at random but those are chosen which seem, upon casual observation at least, to offer

some chance of being diagnostic. The preliminary selection, if astutely done, will save a great deal of time and labor. A serious danger lies in this short cut, however, that the resemblance will be so close as to make training or experience a potent influence in the test score. In a test for clerical capacity the following tasks appeared: finding errors in addition and subtraction; translating prices into letters by means of a code; copying groups of numbers; and reading sentences whose words are spelled backwards. Where such test material is used the test may be found to measure the effects of experience rather than capacity to profit by experience. Figure 65 (*580*, 91) shows the effect of experience upon performance in the relatively simple job of sewing lamp shades. The horizontal scale represents average units of output per

FIGURE 65

EFFECTS OF EXPERIENCE UPON PRODUCTION *



* Adapted from W H Stead, C L Shartle, and Others, *Occupational Counseling Techniques* (New York, American Book Co, 1940), p 91

hour, and the vertical scale represents the number of workers. The solid line stands for the inexperienced group and the dash line for the experienced. Job status in this occupation obviously could not serve as a criterion for job capacity.

The restriction of the tentative list of tests to those that *offer promise of value* may, furthermore, interfere with the discovery of tests that might be highly diagnostic. Much of the success of the empirical method depends upon the insight of the investigator in selecting his test materials.

A test battery for prediction in clerical work might contain as many as ten separate tests, and each of these tests might well contain as many as fifty to one hundred items. One battery of this sort has 461 different items. It is not to be expected that all the tests of such a series will have equal diagnostic significance, hence a weight has to be attached to each according to its relative importance. Finally the separate scores, each properly weighted, are to be combined into a total

score. The statistical techniques for finding diagnostic value, for assigning weights, and for combining scores have been well established and are described in a number of available books on statistical method (*197*) (*231*).

TESTS ADMINISTERED PREVIOUS TO TRAINING

A more valid application of the empirical method would require that a group of persons be tested before receiving occupational training or experience and then followed through their careers to discover what relative degree of proficiency each attains. The relationship of degree of proficiency to previous score in the test will reveal the diagnostic power of the test. The difficulties in such a procedure are obvious, as the standardization process would in some instances require years for completion. Still, the technique is by no means impossible and the results might well justify the cost in time and money. It was tried on a small scale over twenty years ago by Rogers (*529*) who devised a battery of tests for typists and stenographers. He administered nine tests chosen from the Woodworth and Wells (*718*) series to seventy-seven persons who were *about to begin* a course of training in typing and stenography. Their progress in the course was followed and records obtained in terms of quantity and quality of output. Relative standing in the tests was correlated with relative standing in achievement in the course work. The training subsequent to taking the tests could not have influenced test performance, so that, aside from the differential effects of generalized previous experience, the tests could be said to measure native aptitude.

Several applications of this "pre-experience" testing technique have been made on a grand scale. Notable among these is Terman's (*607*, Vol. III) follow-up study of superior children, in which they were subjected to a great variety of tests at an early age and their subsequent careers followed over the years. The investigation is still in progress. There is also the extensive study of children by Woolley (*719*) in which individual careers were followed over a period of years. The most interesting of such studies, because of its direct bearing upon vocational prediction, is Thorndike's (*635*) measurement of 2,225 children in the public schools in New York City, who were approximately 14 years of age, and whose careers were traced during 8 to 10 years subsequent to testing. Twenty-one measures were obtained for each child as of the age of 14 years. Some of these measures were derived from school records such as age, scholarship, school attendance, conduct, and school progress. Others were scores on tests such as clerical intelligence, mechanical adroitness, reading and arithmetic abil-

ity, and abstract intelligence. Items of information concerning each child's subsequent career, to the number of sixteen, were obtained by painstaking investigation. Elaborate statistical corrections were made for disturbing influences such as the changing value of the dollar over the years involved in the study and changing opportunities for employment. Among the items were earnings, job level, job interest, percentage of time employed, and the number of job changes.

With the scores on these many items at hand—the test series obtained at the age of 14 and the other job series 8 to 10 years later—it was possible to compute, in terms of coefficients of correlation, the degree to which the later measures could have been predicted from the former. Such specific questions could be asked as: How well does an intelligence-test score at the age of 14 predict wages at 22 years? How well does a test of mechanical adroitness at 14 predict success in a mechanical job at 22? How well does grade attained at 14 indicate the status of persons in college or university work? The many correlations between the records at 14 years and the later educational achievement will not be considered here, although they constituted the most important finding of the study and gave high promise of predictive value. They are omitted from consideration solely because the present chapter is concerned with vocational rather than educational adjustment.

Table 42 gives a condensed record of the coefficients obtained for the relationships most pertinent to vocational prediction. For a description of the tests used, the methods employed for arriving at such measures as conduct and school progress, and for the exact meaning of earnings, job level, and job interest, the reader should refer to the original report. In the table, the jobs are classified into mechanical, clerical, and mixed, and their meanings will be obvious. The figures in the body of the table are correlation coefficients.

The most striking fact about this table is the small size of all the coefficients contained in it. The largest one, between score in a clerical intelligence test and earnings in clerical work is only +.26, and the next highest, +.22, is between the score in a clerical activities test and earnings in clerical work. These tests and the other items have no prediction efficiency whatever for the career of an individual. Nevertheless, the coefficients are mostly positive which means that in the long run the presence of one will tend to be associated with the presence of the other. Reasons for the low correlations are to be found not merely in the inadequacy of the measures taken at the age of 14, but also in the poor quality of the indicators of status in the later years. One may inquire, for instance: How good an indicator of proficiency is earnings? How good an indicator of usefulness is job level? How good a

TABLE 42

PREDICTION OF VOCATIONAL SUCCESS *

School and Test Records	Occupational Records								
	Mechanical Work			*Mixed Work*			*Clerical Work*		
	Earnings	Job level	Interest	Earnings	Job level	Interest	Earnings	Job level	Interest
Grade reached at age 14, or age when at 8B	.10	.02	.03	.02	—.02	.05	.19	.14	—.01
Clerical intelligence..	.01	—.02	.02	.10	.07	.02	.26	.21	.10
Clerical activities ...	.09	.01	.04	.01	.02	—.04	.22	.16	.08
Stenquist Mechanical I. E. R. Mechanical. Adroitness	} 10	.14	— 07	.14	.11	.11	.19	.12	.04
Arithmetic problems	.08	—.02	.05	.10	.09	.08	.14	.07	.06
Thorndike-McCall Reading Test.....	.06	—.01	.04	.12	.10	—.02	.17	.13	.01
Thorndike-McCall Arithmetic Test ..	.08	—.01	.06	.12	.10	.02	.17	.18	.04
Progress in school...	.06	.02	.00	.05	.01	.04	.14	.12	.01
Average Conduct...	—.01	.07	—.03	— 09	—.04	.07	—.07	—.05	—.01
Average Scholarship.	.04	.07	—.03	.04	.08	.02	.11	.13	.06
Average Attendance.	.00	.02	— 07	—.05	.03	.06	.00	—.03	.05
Age at leaving school	—.06	.07	—.01	—.06	.01	.06	—.15	—.05	—.02
Grade at leaving school	.07	.09	.01	.04	.06	.04	— 01	.16	— 02

* Adapted from E L Thorndike and Associates, *Prediction of Vocational Success* (New York, Commonwealth Fund, 1934), p 58.

measure of interest in one's work is the job-interest measure used in this study? Thorndike concludes:

> There is much evidence that employers do not fit wages to services very accurately in the case of these young workers. Direct evidence also appears in the fact that they pay substantial premiums for mere size in the case of clerical workers! Employers certainly can profit greatly by using tests of intelligence, clerical capacity, and mechanical adroitness for selection of employees. Even if the correlations for tests at the time of employment should be as low as those for tests at age fourteen, and even if the correlations with services rendered should be as low as those with wages received (they probably will be much higher), test scores will be much better than prejudices and superstitions.

The investigation has been reported at some length not to demonstrate the predictive value of vocational tests but rather to show how

the influence of special job training can be eliminated in the use of the empirical method of testing.

THE CRITERION OF SUCCESS

Every vocational psychologist who has worked with the empirical method has recognized the crucial importance of the criterion group in determining the diagnostic value of a test or combination of tests. As Otis (*478*, Chap. 5) has so clearly expressed the matter:

> Unless a suitable criterion can be developed for a study, a large part of the time spent will be wasted It is therefore essential that careful analyses be made of the criterion for each proposed study and that a decision to make a complete study be withheld until it is discovered whether or not a suitable criterion of job performance is available or can be devised.

The degree to which criteria rest upon judgment, and the problems inherent in the judgment process have been discussed at length in Chapter 13. The difficulties to be faced are no fewer when so-called objective criteria are available. This is particularly true when a "criterion of success" is desired. Otis has shown that success in shop work may mean many things, among them high output, influence upon the morale of fellow workers, ability to do extra jobs, ability to acquire new skills, and ability to work without close supervision. Output itself covers speed, quality, and uniformity, to mention no others.

So many difficulties arise in the process of developing a criterion of success that will stand for success in all its various aspects that Otis recommends that one single outstanding component of success, such as quantity produced, be chosen as the criterion where this is feasible and that others be disregarded. Even the combination of speed and accuracy of performance might produce a misleading criterion, for if workers turned out to be fast-accurate, slow-accurate, fast-inaccurate, and slow-inaccurate, a criterion score might not distinguish between the fast-inaccurate and the slow-accurate worker.

Work samples as objective criteria of performance were extensively employed in the standardization of the Minnesota Mechanical Ability Tests (*486*), but the evaluation of these for quality entailed endless labor in the construction of measuring scales that would reduce to the minimum the need for subjective judgment. Even then the subjective factor crept into the matching of work samples against measuring scales.

The whole question of prediction, including the logic underlying it and the techniques that have been evolved to carry it out, have recently been thoroughly canvassed by Horst (*291*). As prediction of

vocational success is one of the four fields used for the purpose of demonstrating the techniques, the document contains valuable material for the vocational psychologist. It gives particular attention to the possibility of using case-study techniques for prediction purposes. These stand in rather sharp contrast to the quantitative statistical methods that are more commonly employed. Interest in case studies for this purpose derives from the sociologists who have used them with success in predicting successful and unsuccessful marriages (*64*) and in predicting the course of criminal careers (*366*). Although the case-study techniques will not be discussed in this chapter, their future development should be carefully followed. No device that has any promise of utility in this field can be neglected.

THE ANALYTIC METHOD

Enough has been said to demonstrate the difficulties inherent in the empirical method and in the use of the criterion group. They have been recognized throughout the history of test making, and there has been an unremitting search for techniques that will make criterion groups unnecessary. One of these is the analytic method. It contrasts sharply with the empirical method in that it consists essentially in the analysis of an activity into the elementary functions which comprise it, and the preparation of devices for testing or measuring these separate elementary functions. Few activities have been analyzed in this fashion. The best-known case, the analysis of musical ability, shows what a difficult and laborious process it is when thoroughly done. But difficult as the analysis of musical capacity has been, it is probably relatively easy compared to the task of breaking down many other complex functions. It would seem inevitable, for instance, that a certain fineness of pitch discrimination would be absolutely essential for musical performance or even musical appreciation. Likewise, intensity discrimination and a certain sense of timing seem equally indispensable.

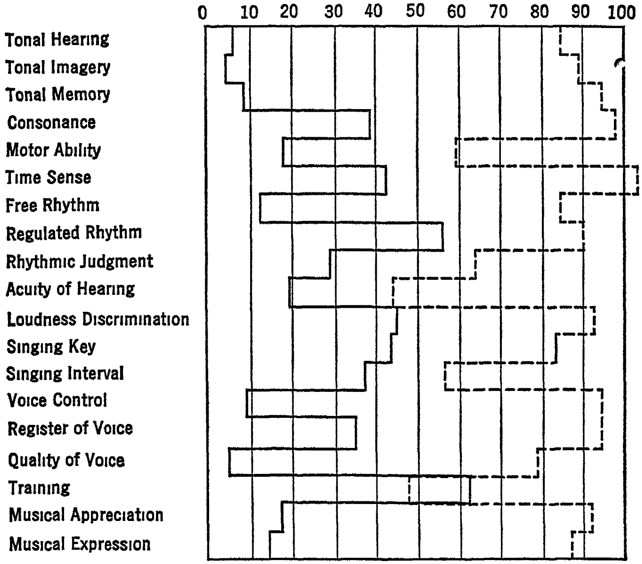
This method, when used in its pure form without subsequent check of the tests against a criterion, lays itself open to the criticism that some very important element in the total process may have been overlooked. Indeed, the success of the method rests heavily upon the keen insight with which the investigator makes his analysis rather than upon the statistical process of measuring the closeness of the relationship between test or test battery and achievement.

A very interesting and important characteristic of the analytic method as employed by Seashore (*547*) in the measurement of musical capacity is his use of the psychograph or profile, through which he shows each test score separately instead of combining all into a total

score. Two such profiles are shown in Figure 66 adapted fiom Seashore. The solid line is the record of "a young lady who is markedly deficient in musical capacity throughout, and has not profited by her extensive musical education"; the dotted line is that of a person of "unusually high natural talent for music, though relatively uncultivated." The names of the different tests are given on the left. A percentage scale extends horizontally, and each record shows in what percentage of the population the person stands in the trait. Thus, in tonal hearing one

FIGURE 66

PSYCHOGRAPHS OF MUSICAL ABILITY *



* Adapted from C E Seashore, "Vocational Guidance in Music," *Univ Ia Monog* (first series), 1916, No 2, 7

of these persons is in the lowest tenth of the population and the other among the best fifth of the population. The score for each trait is to be interpreted in a similar fashion.

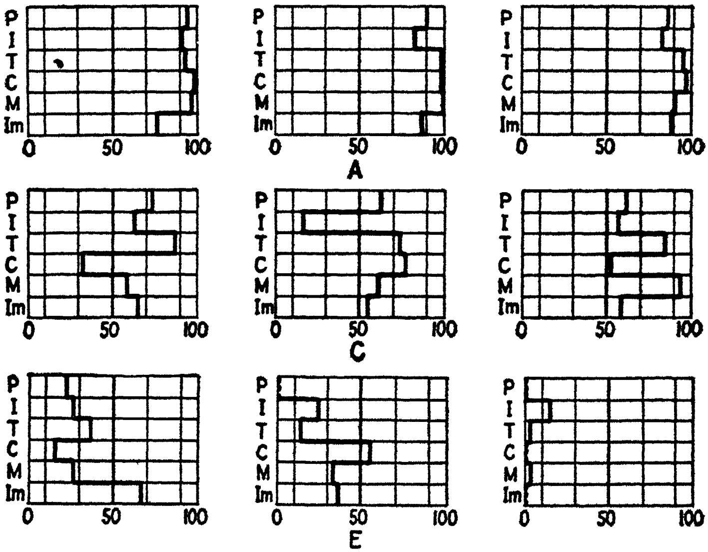
Seashore has devised measures for some thirty separate processes involved in musical ability. To combine the separate scores for these tests into a single total score is not at present feasible, because the relative value of each separate function in determining musical proficiency has not been computed. In fact, it may never be desirable to do so, for one of the advantages of the method is said to be that it portrays in detail the musical make-up of the person, the particular respects in which he is deficient, and the respects in which he excels. The profile method of presenting test data meets, at least in part, the criti-

cism leveled by Johnson (*328*) against total scores whether they are simple sums or are derived from the multiple-correlation technique His criticism is that low level of capacity in any one essential unit of a function will disqualify a candidate no matter how high he may stand in all other units. In other words, one's total score might appear to be acceptable whereas the component scores would clearly disqualify him.

FIGURE 67

MUSICAL PROFILES OF THREE LEVELS *

A = Safe candidates for musical training
C = Possible candidates for musical training
E = Candidates that should be discouraged



* From C. E Seashore, *Psychology of Music* (New York, McGraw-Hill Book Co, 1938), p 316.

One disadvantage of the analytic method arises from the fact that the profile is a kind of clinical picture whose interpretation demands the services of an expert diagnostician. He must weight the significance of "good symptoms" against "bad symptoms" and make his diagnosis in the way that a physician diagnoses a disease. This is a very different matter from accepting a total score above a certain minimum as indicative of capacity.

The diagnosis of musical capacity by the Seashore tests has been simplified somewhat by grouping various types of profiles under five heads as follows (*546,* 316) (*579a*) · To be discouraged; doubtful; possible; probable; safe. These may be identified in terms of centile rank in each of the separate tests. Three of these grades, safe, possible, and to be discouraged, are represented in Figure 67 by three samples of each.

They are actual profiles of applicants for admission to a music school. The horizontal scale shows centiles, the highest and lowest divisions each representing 10 per cent and the intermediate divisions each representing 20 per cent. The letters on the left indicate the tests: pitch, intensity, time, consonance, memory, and imagery.

It should be remembered that the analytic method is intended to yield tests of natural rather than acquired capacity. Although some of the functions measured in the musical psychograph show their resemblance to musical work, they are measured in such a fashion as to minimize the effects of training. Furthermore, it has been demonstrated that pitch discrimination, loudness discrimination, and possibly others of the tests are only slightly modified by training.

THE ANALOGY METHOD

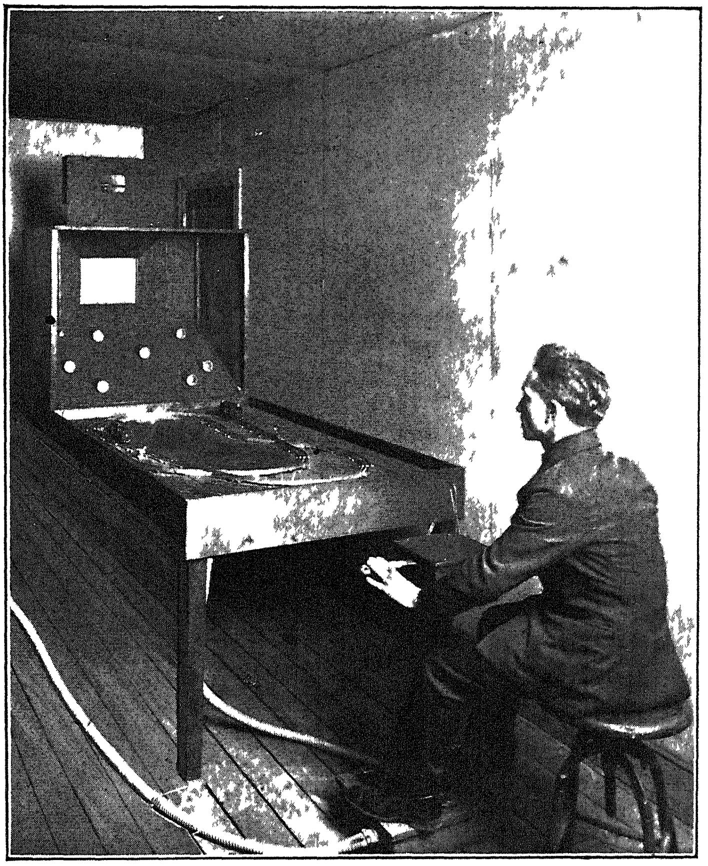
Among the objections raised against the analytic method sponsored especially by Seashore is the contention of Watts (*683*) that the "whole is more than the sum of its parts," whereas the analytic method assumes that "a psychic whole is merely the sum of the factors into which it can be conveniently split up." According to Watts a person might have all the *ingredients* necessary for musical achievement and yet be lacking in musical capacity. This concept of the wholeness of personality was not new even in 1921 when Watts wrote the statements quoted above. As its popularity has increased in the intervening years any criticism resting upon it should receive serious attention.

Watts proposed the analogy method for testing the vocational function in its wholeness. It requires the construction of a test situation which is *analogous to* but *not identical with* the actual occupation, nor merely a sample of it. It implies an analysis of the work into its elements, just as the analytic method, but instead of testing for these elements directly and obtaining a total score or psychograph in that fashion, the elements are reconstructed into a pattern to which the candidate reacts as a whole. The test is, therefore, assumed to call out "as a combination the essential capacities and interests concerned, in much the same proportions as they are demanded in the actual tasks, but in such a manner as to allow potential capacity, when necessary, to compete on equal terms with capacity already fully developed"

This technique not only carries with it all the difficulties inherent in the process of analysis, but the additional ones involved in reconstructing the elements into a "whole task." There is danger that a test so devised will resemble so closely the actual job that it will become a sample test, and thereby give too much weight to training. The Viteles Motor-

FIGURE 68

VITELES MOTORMAN SELECTION TEST (NEW MODEL, 1925) *

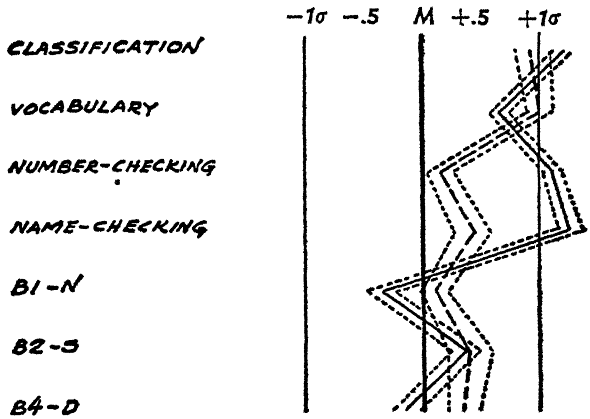


* Courtesy of M S Viteles

man Selection Test (*669*) (*670*) is a good specimen of the analogy type of test. Although the technique by which this test has been constructed is too involved for description here, Figure 68 shows its general character. The candidate is required to operate levers by hand and foot in response to a system of signals that are thrown on the screen. The author considers it an important feature of the test that "the applicant employs, in reacting, approximately the same set of muscles that are used in actual streetcar operation without duplicating the responses used in operating the car."

FIGURE 69

OCCUPATIONAL PATTERNS OF DRAUGHTSMEN AND TEACHERS *



* From A F Dodge, "Occupational Ability Patterns," Teach Coll, Columbia Univ., New York, *Contr to Educ*, 1935, No 658, 65

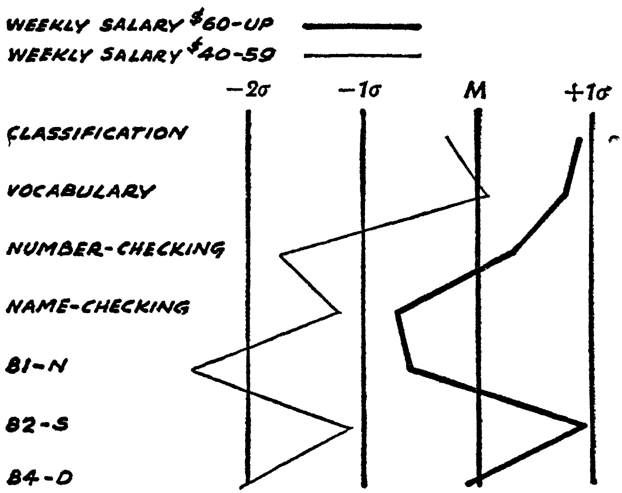
OCCUPATIONAL PATTERNS

The several test methods that have been discussed have their good and their bad points. It seems to the writer that a technique coming into use at the present time has some promise of capitalizing upon the good qualities of these methods and avoiding their disadvantages. It is known as the occupational ability pattern technique and was first extensively used by the Minnesota Employment Stabilization Research Institute (*14*) (*649*) in the measurement of clerical workers and other occupational groups. The individual tests are presented in the form of a profile. Such a pair of patterns from the work of Dodge (*139*) is shown in Figure 69 for a group of seventy-five draftsmen and for thirty-three high-school teachers. The tests are indicated on the left and are The Pressey Classification Test; O'Connor Vocabulary Test; the Minnesota

Vocational Tests for Clerical Workers; and the Bernreuter Test scored in three different ways to yield measures of nervous stability (B1-N), self-sufficiency (B2-S), and social dominance (B4-D). The horizontal scale shows for a total population of 651 persons in eleven different occupations the position of the median and the standard deviation

FIGURE 70

PROFILES OF TEACHERS ON DIFFERENT SALARY LEVELS *



* From A F Dodge, "Occupational Ability Patterns," Teach. Coll., Columbia Univ, New York, *Contr. to Educ*, 1935, No 658, 87

values around the median. The profiles give the standing of the draftsmen (solid line) and the teachers (broken line) within this total distribution. The dotted lines in each case indicate the probable error of the various tests on the profile. As Dodge says (*139,* 64-65):

> If new patterns should be developed from similarly selected occupational groups there is an even chance that each of the points on the new patterns would fall inside the dotted lines.... It is evident that a new pattern for draftsmen would be likely to conform rather closely to our pattern, but a new pattern for high-school teachers must be expected to vary considerably from the pattern for our group.

These profiles are offered for purposes of illustration only. The battery of tests falls far short of being a complete catalogue of essential characteristics in these occupations. The populations on which the scores are determined are likewise inadequate. The ideal list of traits would be one derived from an analysis of mental organization such as that

attempted by Kelley (see page 306) and which would be the same for all occupations.

Another use of the profile is demonstrated in Figure 70 from Dodge (*139*) where profiles for high-school teachers of two salary levels are shown. The tests are the same as in Figure 69, but the profiles themselves are in terms of the minimal score. The chart shows a distinct separation of the qualities for the two salary classes. The occupational pattern technique would make it possible in time to build up profiles representing norms or acceptable minimal scores for many occupations, against which the profile of an individual could be matched for correctness of fit.

The method has not escaped criticism. According to Dvorak (*154*, 174):

> This method has certain disadvantages: it involves subjective judgment in making the comparison of an individual's profile of scores with the occupational ability patterns, and there may be difficulty in deciding how much deviation to allow in an individual's scores in comparison with the average scores represented in the pattern, there may be a tendency to overemphasize the correspondence between the shape of the individual profile and an occupational ability pattern; the assignment of weights to scores must be done subjectively, and it becomes very cumbersome when an attempt is made to compare an individual profile with a large number of patterns for different occupations.

These criticisms are, indeed, valid, though they would be much reduced in force if the patterns stood for minimal scores rather than for average scores. In that case, an individual who has been observed to fall below the pattern in any important characteristic would be disqualified. It is not impossible that weights could be established for a standard set of traits in the case of each occupation very much as Kelley has suggested. Demonstration of the actual practical value of the occupational pattern technique must depend upon painstaking research in the future, a program that will rest heavily upon the statistical methods of correlation. The importance of the discovery and measurement of special human capacities is enough to justify whatever effort is expended upon them.

17

The Rôle of Character in Adjustment

The significance of the intellectual qualities for vocational adjustment has been unduly magnified at the expense of the non-intellectual traits. This state of affairs is due mainly to the availability of intelligence tests and their apparent objectivity, in contrast to the absence of even a clear description of what is popularly known as character. But the very use of the intelligence tests themselves in vocational research has called attention to these other qualities. The moderate size of the correlations between intelligence and success in school and elsewhere suggests the potency of other factors such as perseverance, industry, interest, and endurance. In Chapter 15 it was said that when a certain minimal intelligence requirement has been satisfied, relative degrees of success depend not so much upon the possession of intelligence above the minimum as upon these other qualities. The selective machinery for college students and for professional students is coming to contain some means of evaluating character or personality. Even the genius must get along with other people, unless the State or some foundation should provide an asylum where he may create in isolation. Business, industry, and the professions always have recognized such characteristics and have sought some means for detecting their presence. That they have frequently been misled by charlatans only emphasizes their pressing need for help.

A DEFINITION OF TERMS

Some means should be found for the identification of these traits as a preliminary to their measurement. Popular terms are available without number, but, as in the case of intelligence, it is difficult to divest them of their common meaning. Allport and Odbert (*7*) have prepared a list of 18,000 names in the English language "designating distinctive and personal forms of behavior." These show the "desire to represent by name such mental processes or dispositions of their fellows as can be determined by observation or inference. There is a demand for depicting personality as accurately and faithfully as pos-

sible, for with a suitable term ... the ability to understand and to control one's fellows is greatly enhanced." (*6*, 304)

The most common terms for labeling these general aspects of behavior are personality, character, temperament, and morality, passing roughly from the more general to the more specific. The distinctions among them are, however, not clear cut. Woodworth says (*715*, 136):

> *Character* refers mostly to conduct that can be called right or wrong, that meets or fails to meet the accepted social standards *Personality* refers to behavior which, though not necessarily right or wrong, is pleasing or offensive to other people, favorable or unfavorable to the individual's standing with his fellows The distinction is not always sharp and for our purposes may be disregarded.

Stagner (*576*, 152) implies a similar distinction in the following illustration:

> The habit of avoiding situations involving social participation would be classified as a trait of personality, while the habit of avoiding situations involving participation in "dishonest" acts would be labelled a character trait. Whenever moral or ethical values (evaluative judgments) are concerned, we are dealing with character reactions.

Chassel (*102*) uses the term *morality* to designate the goodness and the badness of behavior.

The characteristics comprehended under the term *personality* by both Woodworth and Stagner seem to fit best the purposes of this chapter. However, since that term is commonly so all-inclusive as to comprise intelligence also, it seems most convenient to adopt the name *character* and to let the term *morality* cover the meaning of goodness and badness. Temperament need not be considered, as that refers more narrowly to emotion or mood.

IS CHARACTER A UNITARY TRAIT?

The problems of prediction, guidance, and adjustment would be remarkably simplified if there were an entity "character," in the sense that there is thought to be an entity "intelligence," which could be measured by a battery of tests as intelligence is now measured. Common speech would seem to imply that one has character, good, bad, strong, weak, vacillating, or dependable. The notion rests upon more than mere popular fancy, however. There is the belief so often voiced by Thorndike (*627*) and others that "in human nature good traits go together." Correlational studies show this, rather than support the opposite view that nature compensates for weakness in one respect by strength in another. Webb (*684*), employing the correlational technique of Spearman by which the concept of *G* (intellect) was

established, has likewise unearthed the general trait of character or self-control to which the symbol *W* (will) has been applied. This, according to Spearman (*573,* 345), is the factor underlying such qualities as perseverance, kindness, trustworthiness, conscientiousness, and cheerfulness.

Downey (*145*) likewise found a unitary factor as the seat of character. The central idea in her Will-Temperament Tests is that people vary in the amount of nervous energy that they can store up, and in the ease or difficulty with which this energy is released into motor mechanisms of the body and thereby transformed into action. These are native qualities called by Downey *will temperament.* She makes a distinction between them and character, the latter being a product built upon these native qualities interacting with intellect, social pressure, and habit mechanisms. To use her own words, "will temperament determines the form assumed by character, although it does not determine its content."

Maller (*392*) has more recently applied the Spearman technique of factor analysis to the data of the Character Education Inquiry of Hartshorne and May (*249*) (*250*) (*251*). He studied the intercorrelations among four groups of character tests, namely, honesty, coöperation and helpfulness, inhibition, and persistence. All the correlations were found to be positive but low, the average being about .24. His analysis disclosed a general factor that could not be identified with *G*, and to which he assigned the symbol *C*. Examination of the characteristics of the four groups of tests led Maller to define *C* as

> ...the readiness to forego an immediate gain for the sake of a remote but greater gain The latter may be remote in time and greater in the sense of leading to other gains of greater magnitude, or it may be remote in being social rather than personal and greater in the sense of affecting a greater number of individuals.

Notwithstanding such findings concerning a unitary character factor, a more prevalent conception of character today is that it is the name for a system of habits, or an individual's way of behaving. According to this view, whatever unitariness there would seem to be would be due to the similarity or uniformity in the various habit systems. These, though tending to be similar, need not be very similar or in fact similar at all. Such is the position of Stagner (*576*), Hartshorne (*248*), May (*250*), and many others. In accordance with this latter point of view, the applied psychologist can no longer hope for a single test of character that will measure it at one stroke, but he does earnestly seek tests for certain important aspects or facets of character. What success he may expect to achieve in this regard will be discussed later.

DOES CHARACTER REST UPON NATIVE ENDOWMENT?

The prognostic value of the intelligence test, especially in long-term prediction, rests upon the presence of a native component in intelligence. Although it is measured in terms of achievement, this very achievement rests upon a native *capacity* to achieve, which gives a certain stability to the IQ throughout life. Is there also in character a stable core of native endowment on the basis of which eventual character traits may be predicated? There would seem to be such a native core in the *W* of Spearman and Webb, in the "reservoir of energy" of Downey, and in the *C* of Maller for those who accept any one of these doctrines. If none of these concepts is acceptable, there is still the possibility of finding something native in character which gives stability to it. It is the behavior of a person or a group of persons that is to be predicted, and, following Terman, one can expect that behavior will be guided by foresight as well as self-control. *Foresight* is the intellectual component and that reduces to a native trait. Furthermore, those who interpret character as habit systems can find predictability in the capacity to learn or to form the character-habit systems, an aspect of native endowment that could be expected to vary from individual to individual. They can find it, too, in the stability of habits once they have been established.

It may also be mentioned in passing that one who should deny any inheritable quality in character might nevertheless look for sound prediction, comparable to the prediction of IQ, in the degree to which character is permanently crystallized during the first five years of life. This will be recognized as the doctrine of psychoanalysis, but it is much more widely accepted than most of the other psychoanalytic concepts. One does not change his "way of life" that is fixed in his earliest years, it is said, but he learns to adjust to it.

It would seem, therefore, that whatever theory of character one prefers, there is some justification for counting upon a native component or upon some permanent core established in the very earliest stages of social life upon which predictability can be presumed. The statement of Allport (*6, 292*) may be tentatively adopted as the point of departure for the vocational psychologist: "However acquired, a trait is always a fusion of habits and endowment rather than a colligation or chain of habits alone."

EVIDENCE FOR NATIVE CHARACTER TRAITS

It should not be surprising to find that experimental evidence concerning the native aspects of character is so meager because an

acceptable answer must of necessity await the development of satisfactory character-measuring instruments. These are only very slowly becoming available in standardized form. In the period before any real tests had been constructed, evidence came mainly from the study of family histories, and usually the histories of such families as were prominent enough to be recorded in biographies or encyclopedias (*708*). What acceptable evidence there is from such family histories suggests that character traits, like intellect, are transmitted from parents to children, but that environmental influences have greater potency in determining the nature of their manifestations than in the case of intelligence.

A promising source of information just beginning to be tapped is to be found in the studies of twins reared apart, which combines the biographical and the testing techniques. Several investigators, notably Newman, Freeman, and Holzinger (*465*) and Newman (*464*), have recorded observations of personality traits along with the measurement of intelligence. The inference to be drawn from their reports is that something is transmitted from parents to children that makes for personality resemblances in the absence of similar environments.

Voelker (*672*) made a pioneer experimental attack upon the problem of the origin of character traits. He attempted to answer two questions: "Can the level of character traits in the individual be raised by training?" and "Will training of a group of children in trustworthiness make the members of the group more alike or more different?" He measured the effects upon two troops of boy scouts of three months of training in the ideals of trustworthiness. Before the training period began he measured the trustworthiness of the group by means of a series of ingenious tests. The results of a retest at the end of the training period, after checking against similar measurement upon two control groups receiving no such training, furnished the data upon which the effects of the training were computed He attributed to the training an increase of about 22 per cent in trustworthiness. The correlation between test and retest was higher in the control group than in the trained group. "This is evidence of the fact that the training took effect in the experimental groups, changing some individuals more than others and thus causing a general shifting in their rank in trustworthiness." Voelker found also that the least improvement occurred in those who made the best record in the first test, and the greatest improvement in those who made the poorest record in the first test. That is, there seemed to be a general "leveling up" in trustworthiness as a result of the training. This is in contrast to the usual finding in

regard to intellectual traits where training tends to increase rather than decrease differences.

To each of his questions Voelker gave a positive answer. Training did raise the level of trustworthiness, and the trained group was more alike at the end than at the beginning of training. His results, and particularly his statistical analyses, are open to criticism. However, his own conclusions, in distinction from the interpretations made of them by others, were fairly conservative. They allow the general statement of Allport to stand (page 327) and warrant supplementing it to the effect that training has a more pronounced effect upon character traits than upon intellect.

THE GENERALITY OF A CHARACTER TRAIT

When the applied psychologist gives up hope of isolating goodness or badness of character, he is ready to accept in the place of such a unitary entity a *series* of character traits. When he does so, he is faced at once with another most important but puzzling question. It is this: *How unitary is a trait?* Is trustworthiness characteristic of all the behavior of the one who possesses it? Does the trait of kindliness mean that one may be expected to be kindly in all his contacts, or are trustworthiness, kindliness, and other social qualities specific to given situations, so much so that the name trait seems entirely inappropriate? Unfortunately there are both conflicting theories and conflicting experimental evidence concerning the matter. Although it is not the primary purpose of this chapter to spin theories, it will be necessary to probe the question somewhat in order to establish some kind of working program for vocational adjustment. The unitariness of a trait is generally referred to as its "generality" or its "consistency." The first term refers to the pervasiveness of the trait throughout the range of behavior and the second refers to the uniformity with which a person acts in a variety of situations. The former term will be adopted for our immediate purpose, and the latter will be reserved as a more appropriate name for another important aspect of character, its stability.

The current theories range from those supporting a maximum of generality to those holding a maximum of specificity (*6*) (*248*). Underlying the controversy is the question of the origin of the traits, and also the question whether and to what extent character traits are habits or habit systems. The notion of extreme specificity stems from the writings of the educational psychologists in the first decade of the twentieth century, notably Thorndike, for whom all learning consisted in the formation of specific habits. Allport (*6*, 249) speaks of the specificity concept thus:

Young children could not learn cleanliness when taught as an abstract principle, but only definite habits of cleanliness, such as brushing the teeth, changing soiled clothing, or washing behind the ears. It may be laborious to instill habits one at a time, but only in this way can the child learn. From this educational dictum, the habit-psychologists found it easy to reach the conclusion that personality is composed of countless specific habits.

EXPERIMENTAL EVIDENCE FOR GENERALITY

The investigation of the trait of confidence by Trow (*652*) supported the concept of extreme specificity. He measured the degree of confidence of forty-two people in reacting to sixteen test situations. These forty-two persons were ranked in the order of their confidence separately

TABLE 43

THE SPECIFICITY OF CONFIDENCE *

Individual	*Range in Confidence*	*Individual*	*Range in Confidence*
1	1 0 to 35.0	22	2.0 to 40 0
2	1 0 to 37.0	23	3.0 to 34 0
3	1.0 to 36 5	24..........	14.0 to 41.0
4	3 5 to 27.0	25..........	2 0 to 41 0
5	9 5 to 34 0	26	2.5 to 32.0
6	2 5 to 35.5	27	2 5 to 38 0
7	11.0 to 40.0	28	6 0 to 42.0
8	4.5 to 35 0	29..........	13 0 to 40.5
9	11 0 to 41.0	30	14.0 to 42.0
10	2 5 to 34 0	31	5.0 to 42.0
11	5 0 to 42 0	32..	3.5 to 41 0
12	2 0 to 29 0	33	1 0 to 37.0
13	4.0 to 33 0	34	14 0 to 41 0
14	13 0 to 40 0	35..........	1 0 to 41.0
15	1 0 to 34 0	36	1.0 to 42.0
16	2 0 to 42 0	37........ .	5 5 to 42 0
17	1 0 to 33 5	38..........	3.0 to 39 0
18	5 0 to 27.0	39	1.0 to 41 0
19	9.5 to 38.5	40	5.5 to 41.0
20	1.0 to 37 0	41	4.5 to 36 5
21	11 0 to 41 0	42.	4 0 to 42 0

* Adapted from W C Trow, "The Psychology of Confidence," *Arch Psychol* (New York), 1923, No 67, 37.

for each of sixteen tests. Thus the degree of confidence of any person in any given test may be expressed in terms of his standing in the group of people, and the variation or shifting of his confidence from one situation to another is to be inferred from the variety of relative positions that he occupied in the different tests. Table 43 shows the range of positions for each of the subjects in the sixteen tests, the maxi-

mal range being, of course, from 1 to 42. The average range of confidence for all subjects is over thirty positions or points.

> Any test of confidence, then, which does not cover a wide number of situations is futile, as an indicator, and its predictions will as likely be wrong as right. The traits are not constants, but vary with the varying situations.

Other investigators have found signs of some degree of generality. Thus Voelker (*672*), in the investigation previously described, found the average correlation between one of his tests and three others to be +.28, and the average correlation between three of the tests and the total score from all the tests to be +.48. Although these may seem low, they nevertheless indicate some degree of generality. Similarly Woodworth (*715*, 159) finds, in the data of Hartshorne and May, that the various tests of cheating in copying answers correlate +.70, and that the tests of the tendency to overstate one's performance in various gymnasium feats correlate +.46. On the other hand, the relationship between these two kinds of opportunity to cheat is reflected in a correlation of only +.20. Hence the ability to predict cheating from one situation to another would seem to depend upon the degree of similarity between the two situations.

The commonly used split-half method of measuring reliability of a test is in one sense a measure also of the generality of a trait. In this technique, score on one half of the test is correlated with score on the other half. (The halving may be done in different ways.) Determined in this way, generality appears to be somewhat higher than the figures just given. Reliability measured by means of duplicate forms gives coefficients that tend to lie somewhere between those from the split-half technique and those derived from tests for similar functions.

GENERALITY-SPECIFICITY THEORIES

From data such as these there has arisen the concept of habit systems or constellations, the unifying influence being the identity or partial identity among the situations to which reactions are made. This will be recognized as the concept of identical elements taken over directly from the theory of transfer of training into the field of character formation, and seems to be the prevalent view from which current character-development programs are derived.

Stagner (*576*, 130) describes the personality trait as a generalized habit thus:

> The trait may be considered as a response which has been generalized to cover a wide variety of situations. This view has been implied in some of our

previous discussions. It assumes that the learning process by which we acquire responses to social situations may be such that we respond to the unique qualities of a total situation, or to some element of the situation which is also present in other situations If the latter be true, we may expect that many situations which are different except for this common element may still arouse similar behavior. If a child, for example, has numerous painful experiences involving the presence of other people, he may develop a generalized avoiding response to all occasions which bring him in contact with others.

According to this view we should say that a trait of self-confidence was due to a habit of success which had become sufficiently generalized that the child approached all situations with an expectancy of victory. A trait of conservatism might be due to a number of experiences with strange conditions, in which the individual was doing things he had not previously attempted, so that he became habituated to avoid new or unusual situations and ideas.

Allport (*6*) goes beyond the notion of trait as a generalized habit. It is, according to him, independent in function if not in origin from any specific habits, and may determine the course of behavior in an entirely new and unique situation. It is Allport's contention that the specificity of traits such as trustworthiness is so only to superficial observation. A more thorough analysis, he says, will reveal consistency within the individual. Thus a boy, thoroughly trustworthy on all other occasions, suddenly takes to stealing when goaded by his companions to do so. Although inconsistent or specific in the stealing reaction, he was entirely consistent in that he was acting in response to his *major* desire for admiration and social standing. "The less stable habits of honesty were destroyed by a stronger and more organized *trait*. The boy was consistent enough with himself, but his consistency did not happen to correspond to the social ideal." His specific untrustworthiness was traceable not to a trait that could be so named, but to a need for social standing. A similar discrepancy between inner urge and overt behavior is cited by Murphy (*449*, 870) who says:

One's enjoyment of games of chance may involve an interest in social gatherings, a desire to escape from hard work, a desire to win prestige, or prestige and money together, and a great many other habitial interests.

THE VOCATIONAL COUNSELOR'S CHOICE

Just here a serious difficulty arises for the vocational psychologist who would measure character traits. He must measure behavior and look for reactions that will conform to social ideals, or even more specifically, to business ideals. He searches for the candidate who will be *trustworthy in spite of other conflicting or interfering tendencies.*

The same might be said for all other character traits where practical measurement is called for, since one wishes to predict behavior rather than ideals within the personality.

However much one might favor the concept of the trait as an independent entity, practice would demand that he treat it as a collection of specific habits or as a generalized habit reaction to differing specific environments, at least until methods of selection and guidance can come to rest upon an analysis of the total personality. Having adopted this position in regard to the trait, its measurement would call for a test comprising an adequate sampling of all the situations in which the trait manifests itself. That test would be the best, other things being equal, that afforded the most adequate sampling. An adequate self-assertion test might have to sample reactions toward supervisors, equals, and inferiors; an honesty test should sample reactions where the stakes are small, medium, and large; a truthfulness test should measure everyday matters of little consequence, as well as the kind of crisis where a lie might save one's job. Such is the trend in character-trait measurement, laborious as it is. Hartshorne and May employ a battery of tests for the single "trait" of trustworthiness that compares in magnitude with an intelligence test. Watson (*681*) finds a sizeable battery necessary for the measurement of fairmindedness. Even the questionnaire type of test such as those measuring introversion-extroversion, and ascendance-submission, call for many and varied responses. The ideal character measure, moreover, would be one that determined not merely whether or not a person is honest, but how honest he is—how far through a graded series of provoking situations he can go without "breaking down," or perhaps how trivial the situation must be before resistance "breaks down" (*403*).

CONSISTENCY OF CHARACTER TRAITS

The term *consistency* has been reserved to indicate the degree to which an individual will respond in a similar fashion to the same situation at different times. If one were interested in the "behavior" of a test rather than of a person or a group of persons, he would speak of reliability, and would be measuring it by the "repeat technique." Reliability coefficients will, therefore, give some clue to the consistency of reaction on different occasions.

Such data as are available show relationships whose size depends in part upon the exactness with which the test situation has been duplicated and upon the length of the time interval between testings. For example, the reliability of the Bernreuter Questionnaire determined by retest is in the neighborhood of .85 for the various scorings and for short time

intervals. Stagner (*576,* 140) reports correlations as shown in Table 44 for repeated tests after intervals of one year and of two years.

Stagner (*576,* 147) also makes a comparison of the personality traits of 132 college students, as measured by means of tests, with their

TABLE 44

REPETITION OF BERNREUTER TEST AFTER LONG INTERVALS *

	Nervous State	*Self-Sufficiency*	*Dominance*
1 year, 30 cases	.78	61	.53
2 years, 15 cases...	67	38	.54

* R. Stagner, *Psychology of Personality* (New York, The McGraw-Hill Book Co, 1937), p. 140

personality traits as they recalled them from childhood. He recognizes, of course, the dangers inherent in such retrospective reports but feels justified in drawing the following conclusion concerning consistency in personality trends:

> The general implication of these results is obvious. Either the child inherits tendencies toward these personality traits (emotionality, self-esteem, shyness, seclusiveness) or he acquires them early in life. The adolescent who is emotionally sensitive has a childhood which was filled with more emotions than the average, or at least he feels that it was. In the same way, the college student who lacks self-confidence seems to have been that way for a long time. The seclusive individual, too, seems to have been practising this habit for many years

Such amounts of consistency as these data show are looked upon as satisfactory and encouraging by those who work with them in the laboratory. There are at least three reasons why they should not be expected to be higher. First, the tests are not so good as they might be and on this account they may fail to measure the real tendency to respond in a uniform fashion. Improvements in the tests may, therefore, be expected to improve predictive power. Second, manifestations of character traits are, like all behavior, reactions to situations always complex and varying from time to time. To take the same test on two different occasions probably means that only the test material itself is identical on the two occasions. The examiner may be a different one, and the second day's events may constitute an entirely different pattern of satisfying and annoying conditions from those of the first. And third, if character traits are habit systems, a certain amount of change in them should normally occur. One never ceases to learn and to form new habits, and this process is particularly rapid during the period when vocational counseling is most needed. Only in later years of life do one's habit patterns become crystallized.

It will be noted that this third factor differs from the other two in that it signifies an actual change in character, whereas the others represent errors in the true measurement of it. It will not be easy by means of tests to tease out the effect of the former and to determine its significance as an obstacle to prediction.

OCCUPATIONAL CHARACTER PATTERNS

The foregoing discussion has disclosed several serious difficulties in the way of character-trait measurements for practical vocational purposes. The most important of these are their susceptibility to change through training and the accumulation of experience; their dependence upon many environmental circumstances; and the specialized nature of the character reactions.

There are, in addition to these, all the difficulties and problems that have to be faced in the construction and standardization of any kind of test, such as making it valid, making it reliable, preparing equivalent forms, and so forth. All that has been said about the setting up of criterion groups for the validation of special ability tests is particularly pertinent here. The final recourse in the one case as in the other is to judgment and opinion. And it should be recalled that validation by the customary techniques calls for judgment of those very characteristics that are most intangible and least objective in their manifestations and hence most difficult to estimate.

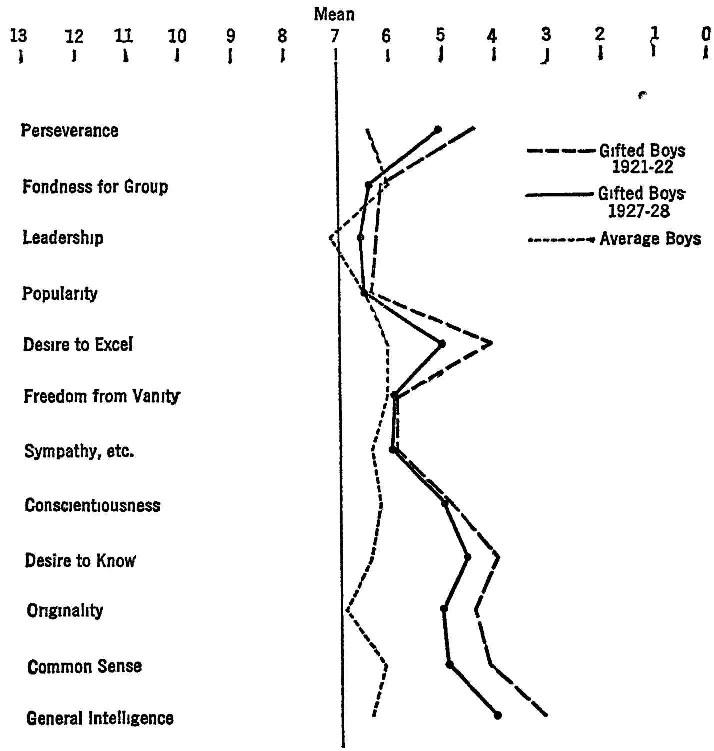
The situation, however, is far from hopeless. When an amount of time and energy equivalent to that given to the standardization of intellectual measures shall have been spent on character measurement, practical vocational tests can be confidently expected. The uses to which they will be put need scarcely be mentioned. Everywhere they will supplement the tests of intelligence and special abilities. In the higher and more complex vocations where the intelligence tests are not diagnostic, although they are invaluable for establishing minimal levels, it may well be that character tests will disclose the traits that are significant for success. Downey, many years ago, described a few occupational requirements in terms of her own test as follows (*145*):

> The executive requires high speed of movement and decision, freedom from load, motor impulsion, reaction to contradiction and opposition, finality of judgment. Interest in detail and perseveration are not essential and perhaps are detrimental.
>
> The research man requires a high degree of perseveration, interest in detail, a slow and critical judgment with a tendency to revise decisions, lack of freedom from load, difficulty in shifting from one thing to another. Flight of time should not impress him unduly.

There is an extensive and growing literature concerning personality *maladjustments* in industry and business from which one may indirectly infer the requirements for successful adjustment. The studies of Whitehead (*703*) in industry and of Anderson (*13*) in business are excellent samples of this approach. These along with others are surveyed by Young (*730*). Many of the problems discussed by the last of these authors will receive attention in succeeding chapters of this book.

FIGURE 71

CHARACTER PATTERN OF AVERAGE AND GIFTED BOYS *



* From L M Terman, *Genetic Studies of Genius* (Stanford University, Calif., Stanford University Press, 1930), Vol 3, p 186

The goal to aim at, although it is still remote, would seem to be some kind of occupational character pattern resembling the occupational ability patterns that promise so much in this related field of measurement. In fact the occupational patterns reproduced in Figures 69 and 70 have in them several personality components, namely, three Bernreuter Test scores. A more comprehensive pattern for purposes of illustration is given in Figure 71. It is adapted from one prepared

by Terman (*607*, Vol. III, 186) and shows the mean ratings by teachers for gifted boys in 1921-22 and again in 1927-28, also for a control group of average boys in 1921-22. The original ratings have been translated into the numbers from 13 (lowest) to 1 (highest), where 7 is the mean rating. Several interesting points are disclosed in this chart. The gifted boys rank higher in every one of the 12 traits except Fondness for Groups and Popularity. The ratings on the majority of the traits are lowered after an interval of six years. And finally, there is the fact that the control group, which is supposed to represent the average, lies above the midpoint, which is 7. The discrepancy is due to what Terman calls the "generosity factor" in rating, tending to place a person higher than his real position.

The characteristics that were measured by Terman are not ultimate and irreducible units of mental organization. The goal to which reference was made above is one in which such essential character traits should be established once for all, presumably by some factor-analysis technique or some form of personality analysis such as that of Murray (*452*). The amount of these essential traits needed for any occupation could be worked out, and individual patterns checked against these requirements.

Allport (*6*, 402-404) has prepared and employed a psychograph or profile of personality traits that represents at least an approach to the ultimate pattern. He states, however, that his list of traits is tentative and subject to change. It comprises:

Ascendance—Submission
Expansion—Reclusion
Persistence—Vacillation
Extroversion—Introversion
Self-objectification—Self-deception
Self-assurance—Self-distrust
Gregariousness—Solitariness
Altruism—Self-seeking
Tact—Tactlessness
Theoretical—Non-theoretical
Economic—Non-economic
Religious—Non-religious
Political—Non-political
Broad emotions—Narrow emotions
Strong emotions—Weak emotions

Allport makes another and a far more serious reservation in presenting his list of traits. It is that no personality can be accurately represented in a profile since it must necessarily fail to express the qualitative balance between two or more traits. Behavior, for him, is always a blend colored by all coexisting traits; it eludes the psychograph completely. This criticism of a character profile becomes an even more serious indictment of any single character-trait test, for it too would surely fail to reflect the blend of all coexisting traits.

The vocational psychologist can, nevertheless, rely upon the empirical method used in the measurement of special capacities to derive practical measuring devices for specific character traits. If he does not try to

predict too remote events, if he does not count too heavily upon the generality of a trait, and if he incorporates into his test a sufficiently large number of samples of the behavior trait, prediction can be made with a measurable degree of probability. If one wishes to know the trustworthiness of bank clerks, he will do well to test for trustworthiness in the banking situation; if he wants to know the honesty of children in school examinations he will do well to direct his tests to that end. In the meantime, research should be continued into the fundamental character traits and their generality and stability in order to pave the way for more economical character-measuring tools.

18

Interests and Attitudes in Adjustment

Analysis of vocational adjustment has yielded thus far the factors of general intelligence, special capacities or aptitudes, and what the author has chosen to call character traits. The significance of these has been discovered in the order named, and each in turn has occupied the focus of research interest. There are many indications from the field and from the laboratory that the inventory is still incomplete. Evolution in the world of work has been bringing more and more clearly into the open a changing interpretation of successful adjustment. Success can no longer be defined in terms of output of work or of financial return; some place must be given to enjoyment of work or satisfaction from it. This aspect of work is so important that a later chapter will be devoted to the discussion of it. But it may be stated here that adjustment on the basis of intelligence and of special capacities does not guarantee the presence of this newly discovered component. Placement of an individual according to character traits comes nearer to doing so, but even that does not tell the whole story. Laboratory investigations have brought to light such factors as motivations, attitudes, and purposes, and have demonstrated their potency in correct adjustment. Strong (*588*) has emphasized these factors in his contrast between aptitudes and attitudes, the latter term having about the same meaning as the term interest.

A DEFINITION OF INTEREST

It is not an easy task to furnish a definition of *interest* that shall at the same time conform to technical and scientific requirements and be applicable to the practical problems of vocational adjustment. The word itself had a long popular history before it was adopted for scientific usage, and, as in the case of the words intelligence and character, some confusion has arisen from the mixture of the scientific and the popular. The word is derived from the Latin *inter* (between) and *esse* (to be) and means "to be influenced by." The Warren Dictionary of

Psychology defines it thus: "A feeling which accompanies special attention to some content; an attitude (readiness to react) * characterized by focusing attention upon certain cognitive data." This definition makes interest both a feeling and an attitude. Woodworth (*710*, 74) proposes a very similar two-fold definition: "From the introspective side, an interest is somewhat similar to an emotion; from the side of behavior, it is a drive towards activity of the capacity to which it is attached." It is not difficult to perceive the relationship of the popular meaning to these more technical meanings. One is interested in what he likes, and he is interested in doing what he likes to do. Feelings, attitudes, and "liking to do" are the essentials of every definition of interest. Focusing attention upon the pleasant feelings or measuring them provides one kind of indicator of interest, and focusing attention upon preferred actions or measuring them gives another kind of indicator. Here one will find clues to the two most common techniques for measuring interest. A third measures the consequences of pleasant feelings or of preferred actions in the form of knowledge acquired, information accumulated, or skills attained where a sufficiently varied environment has made a range of choice possible.

INTEREST AND KNOWLEDGE

If being interested in something means liking it, the problem of interest measurement would seem to be a very simple one. It should merely be necessary to inquire whether one liked this, that, or the other occupation, recreation, book, or play, depending upon the purpose of the inquiry. The earliest procedures were just as simple as this. When Thorndike (*620*) measured the interest of students in their school subjects, he had them arrange these subjects in order of liking for them. He even measured the change of interests with age by calling for retrospective reports of early likes. It should be noted particularly that the students rated studies with which they were acquainted, that they either were taking at the time or had taken previously. Criticism of this early work on the ground that liking was confused with ability, and that past liking was confused with present liking need not be dealt with at the moment.

The early *prediction* of interests for purposes of educational or vocational guidance by this simple technique required the expression of likes for occupations and the statement of relative degrees of preference. Thus, Poull (*509*) obtained the occupational and recreational choices of sixth-grade public-school children twice at an interval of

* Parenthesis inserted by the author.

six months. The children were asked to express preferences among sixty-nine occupations such as those of the architect, author, electrician, judge, minister, and professor, and among 104 recreations such as aviation, gardening, opera, sculpture, and writing poetry. It will be obvious that the children could have only a most superficial acquaintance with these activities or no acquaintance at all. Any satisfactory basis in knowledge and information for an expression of like or dislike must have been lacking.

The method of direct expression of likes as a measure of interest fails in the absence of adequate knowledge, or experience. It is pertinent to inquire, therefore, whether the requisite knowledge for the expression of likes and dislikes can be made available. Much effort has been expended during the last twenty-five years in the attempt to furnish information upon which expression of likes and dislikes might safely rest. The means of furnishing the adequate background of information might consist of talks on what it means to be a doctor, lawyer, or preacher such as are frequently given to college students who are expected to choose a major course of study. Or it might consist of a series of booklets, such as the "Careers Research Monographs." * The book on Public School Administration contains the following material:

What is Public School Administration?—History—The General Duties of the School Administrator—Attractive Features of the Work—Unattractive Features of the Work—Types of Positions (PRINCIPAL A Week with the Principal; SUPERINTENDENT Relationship to the Board of Education; Selection of Personnel, Influence on Instructional Program, Supplies and Textbooks, Research; Finance, Public Relations; A Month with the Superintendent; A Typical Day)—Other Positions in Public-School Administration (THE SUPERVISOR Summary of a Year's Work Done by a Supervisor)—Other Officers (BUSINESS MANAGER: State Departments of Education)—Getting a Start—Salaries—Tenure—Training (including a list of Graduate Courses for Administrators)—Personal Qualifications — Professional Associations — Periodicals — Suggested Readings.

These booklets have been carefully prepared and widely circulated, being available in many town, public-school, and college libraries. It should be noted that each book attempts to describe a typical day's work in addition to furnishing a variety of valuable information about wages, availability and distribution of jobs, opportunities for advancement, and so forth.

A third means of imparting occupational information consists in sampling various jobs, as is very frequently done in vocational and trade schools. For instance, the Junior High School described by Pater-

* Prepared by the Institute for Research, Chicago, Illinois.

son (*486*) and associates provided ten weeks of experience in each of a series of shops for sheet-metal work, mechanical drawing, woodwork, printing, and electricity. The experience is intended to permit direct knowledge of the everyday duties of an occupation on the basis of which students can express their relative likes and preferences.

All three of these methods are good so far as they go, but each is definitely limited in the range, completeness, and realism of the information. All are most useful in the simpler occupations. It is obvious that actual trial could not be arranged in the professions, and that printed descriptions might fall far short of telling the whole story. But even in the simpler forms of mechanical work a few weeks of training set up much like school work might not reveal latent interest.

THE TESTS OF INTEREST

Since most of the characteristics of interest that will be discussed in this chapter are derived from the measurement of interest by one means or another, understanding of them will be facilitated by knowledge of the measuring techniques. As suggested above, interest tests can be classified into three groups, namely, those that measure likes, those that measure preferred actions, and those that measure the consequences of likes and preferences.

1. *Tests that measure likes and dislikes.*—The obstacles encountered in the attempt to guarantee adequate knowledge for the expression of likes, together with the urge to detect interests through them, has led to the application of testing techniques to the problem. The assumption underlying this approach seems to be that the salient characteristics of various occupations can be found by a kind of job analysis, and that one can express like or dislike for these characteristics without any acquaintance whatever with the job of which they are a component, or without knowing to what job they belong. The earliest trials (*192*) of this idea were concerned, fortunately, with the measurement of interest in the selling of insurance, and the first stages of standardization of the tests called for distinguishing interest in selling from interest in mechanical work. The most significant aspect of selling is contact with people of all sorts, and the most significant aspect of mechanical work is contact with inanimate objects. Freyd (*189*) (*190*) compiled a series of statements to some of which socially inclined people might react favorably, and to which non-socially minded people (mechanically minded) might not so react. A few of the statements and the responses called for are shown on the next page. When the statements were submitted to fifty-nine men, thirty of whom were studying for mechanical occupations and twenty-nine of

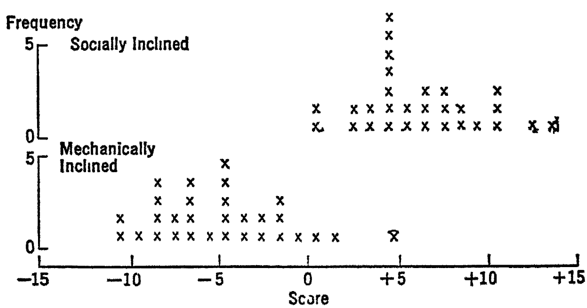
Draw a circle around one of the symbols after each of the items below:

Fat men	L	?	D
Feeble people . .	L	?	D
Nervous people	L	?	D
Solitaire	L	?	D
Picnics . . .	L	?	D
Football	L	?	D

whom were preparing for salesmanship, the two groups were clearly discriminated by their respective "like" and "dislike" scores. The distributions of the two groups on their scores in this "test" are shown in Figure 72. The base line represents like and dislike scores; plus signs meaning like, minus signs meaning dislike, and the zero being

FIGURE 72

DISCRIMINATIVE VALUE OF AN INTEREST TEST*



* From M Freyd, "The Measurement of Interests in Vocational Selection," *J Person Res*, 1922, *1*, 323.

the neutral area between the two. Each of the fifty-nine persons is indicated by an x on the chart. Thus the rudiments of the empirical method of testing came to be applied to the measurement of interest, namely the assembling of a series of "promising" items and a check of them against criterion groups.

It is essentially this procedure that has been developed and expanded into the Strong Vocational Interest Tests, the best standardized and most widely used of all interest-measuring devices. The following statement by Strong (*596*) gives in a few words the justification for his test:

Men engaged in a particular occupation have been found to have a characteristic pattern of likes and dislikes, which distinguish them from men following other professions. Scores on the Vocational Interest Blank are a measure of how nearly a man's interests coincide with those of the average man successfully engaged in a certain occupation.

For the purposes of this test it is assumed that a man will be more effective in his vocational career if he is engaged in work that he likes than if he is forced to do a great many things that he dislikes If he is given his own free will in the matter, it is apparent from surveys made at Stanford University that his general interest will, to a surprising extent, influence his choice of a career.

The Interest Blank for men comprises 420 items for which one is required to express *like, indifference,* or *dislike*; to state a preference for certain alternatives; or, in certain cases, to rate his present abilities and characteristics. Standards have been set up for thirty occupations, and one and the same blank is scored according to a specific scoring key for each of these. It should be noted that the criterion group in each case is a population of men "successfully engaged in a certain occupation," ranging in number from 50 to 382. Two critical scores are established for each occupation. The first separates the 75 per cent of the criterion group making the highest score and called *A,* from the remaining low 25 per cent, called *B*. The second critical score separates from the *B* group those making scores so low (not more than the lowest 2 per cent of the whole criterion group) as not to be often found in the occupation, "and if they are so engaged are either indifferent successes who will soon drop out or are carrying on the work in some more or less unusual manner." These are called *C*. A rating of *A* means that the person has interests appropriate to the occupation; a rating of *B* leaves the question uncertain; and a rating of *C* means absence of the appropriate interests.

As in the use of the critical score for prediction on the basis of intelligence and special-ability tests, the interest test is not intended to predict degrees of success within an occupation whose interest is indicated. However, Strong (*595*) (*596,* 14) has obtained data concerning the relationship between interest rating and amount of insurance sold as given in Table 45. The largest number of *C* individuals are found in

TABLE 45

RELATION OF INSURANCE SOLD TO INTEREST RATING *

Average Amount Sold in Thousands	*Number of Cases*	*Percentage of Each Interest Group Selling Given Amount*				
		C	B—	B	B+	A
0—49	19	31	20	17	21	2
50—99	37	44	20	33	26	13
100—149	29	12	20	17	8	18
150—199	40	6	20	28	16	26
200—	56	0	20	5	29	41

* From E K Strong, *Manual for Vocational Interest Blank for Men* (Stanford University, Cal., Stanford University Press, 1938), p 14

the lowest selling group and the largest number of *A* individuals are in the highest selling group.

The question naturally arises whether the likes and dislikes within the occupational groups are not acquired in the course of experience with the job, just as special abilities may have been acquired in the course of trade training and experience. The most straightforward way to neutralize this probability would be to give the tests previous to training and then follow the cases through to ultimate success or failure. Strong has embarked upon such a long-term program but, until his research is completed, trained groups must continue to form the criterion populations.

The most important point about this like-dislike type of test is that it seems to avoid the necessity of direct job knowledge since the content of the test items bears no resemblance to specific occupations.

2. *Tests that measure preference in terms of action.*—The best illustration of this method, which has been relatively little used, is the study by Nixon (*467*), who was concerned primarily with the attention and interest value of advertisements. He measured the direction in which the eyes were turned when two objects were exposed within the field of view, and the proportion of a fixed exposure time spent looking at the one or the other object. Not only the assumptions on which the technique was based, but also his findings suggest that he was dealing with a direct and immediate symptom of interest. He assumed that the eye will turn toward and linger upon what is liked, and he found that his observers were interested in pictures, in color, in suggested action, in food, in women and children, rather than in large space, complex layout, border arrangements, or kinds of lettering. Concerning the interest value that comes from pictures of people, he says:

> By every one of our measures, with each group of advertisements used and with every group of subjects, we find a marked superiority shown by groups of advertisements having pictures of people. This superiority is so great that this factor deserves to be considered as one of the most important in any study of attention and interest in advertisements.

The potency of interest in people to determine direction of attention suggests the possibility of detecting in this way the differences between interest in people and interest in things, which seems to play a part in occupational preferences. The technique might be used to detect still other interest trends.

The Distraction Test of Burtt (*72*), although not so immediate a test of action as the one just described, nevertheless measures the immediate consequences of the direction of attention. It was essentially a test of the distracting power of ideas in which one is assumed to be

interested. The task set for the individual consisted in checking as rapidly as possible a number of meaningless words which were scattered at random through a paragraph of "interesting" material. The distracting power of the "interesting" material was calculated from the difference between the speed of checking through such a passage and through a "non-interesting" one. The greater the delay caused by the "interesting" material the greater the interest. It would be only necessary to choose passages representing different occupations in order to make a proper diagnosis. The test yielded correlations between known interest and interest shown by the test of +.25 to +.30, when the factor of ability was ruled out. Although this correlation is too low to be of service, the distracting power of interest is a genuine phenomenon and may furnish the nucleus for a useful type of test. The method seems promising enough to warrant a more thorough trial than it has received and with a more satisfactory criterion group.

3. *Tests that measure the indirect consequences of interest in the form of associations established, information acquired, and skills attained.*—The Free Association Test of Wyman (*728*) measures the relative readiness of various associative connections to function, the assumption being that this readiness is a function of interest. The test was devised and used by Wyman and Terman not for vocational prognosis but for classification of gifted children according to their intellectual interests, social interests, and activity interests. A list of 120 stimulus words was selected, each one of which was "equally adapted to provoke responses due to the three interests." For instance, one of the stimulus words, gem, might have and in fact did, arouse the response ruby, razor, and exercise, the first attributed to intellectual, the second to social, and the third to activity interests. From the 120 words two equivalent lists of sixty each were selected. Standardized scoring was derived from criterion groups of children judged by their teachers to have predominantly one or the other type of interest. The three responses to gem mentioned above received the following scoring values based on the frequency of response in the three criterion groups:

	Ruby	*Razor*	*Exercise*
Intellectual interest......	20	3	3
Social interest	11	9	9
Activity interest	15	6	12

The reliability coefficients of the scores for twelve-year-old girls and boys was about +.85. The validity determined by checking against teachers' ratings of the children's interests was for intellectual interest +.65, for social interest +.50, and for activity interest +.31. The first two compare favorably in validity with tests of intellectual and special

ability. The third is not so high. All are high enough to justify the use to which the test was put by its author, and to suggest the possible utility of a similar technique in vocational interest predictions.

Cantril (*80*) has found that interests determine the *speed* with which controlled association reactions occur. Using the six categories of aesthetic, economic, political, theoretical, religious, and social instead of the three used by Wyman, he found a positive correlation between the presence of the interest and the speed of association. The coefficients varied in size from +.104 (social) to +.855 (aesthetic).

McHale's (*417*) Vocational Interest Test for College Women illustrates the use of information as an indicator of interest. The assumption underlying such tests is that interest determines in part what will be learned, what will be retained, and what will be recalled so that, other influences being equalized, differences in information will signify differences in interest. The test comprised multiple choice questions from the fields of law (thirty-three), business (thirty-five), medicine (thirty-eight), homemaking (sixty-nine), agriculture (thirty-nine), and education (thirty-two). The main source of error in information tests resides in the fact that interest is only one of the determiners of available information, and that ability rather than information may be measured by them. The very puzzling question of the relation between interest and ability comes to the fore here, but its discussion will be postponed to a later page. It is sufficient to note that neither this type of test nor any other that shows any promise as a measure of interest should be discarded without a thorough trial.

No skill-measure of interest need be described in detail. Such tests presuppose that one who is interested in a field of activity will be more likely to show skill in it without specific training than one who is not so trained. A boy with mechanical interests could be expected to know how to handle tools from seeing others handle them, to be able to do odd mechanical jobs and to tinker around the house from observing the handy man at work. The writer knows of no performance tests specifically designed for the purpose of measuring interest, neither does he know why one should not be attempted, with adequate precautions against confusing ability with interest.

THE ORIGIN OF INTERESTS

Adjustment on the basis of interest implies a certain minimum of stability, permanence, or at least some continuity of trend over a period of time. Purely evanescent interests will not suffice for prognosis. Can one in any sense call interests native, or find a native core or predisposition of some sort upon which stability might be indicated? There is

much evidence of the anecdotal sort showing that occupational interests, or at least occupations, run in families, and the same may be said for hobbies. Careful statistical surveys such as those of Cattell (*97*) and Brimhall (*60*) help to tease out, to a certain extent, the influence of environmental from hereditary influences, leaving certainly a smaller proportion of influence to innate factors than anecdote would lead one to expect, but not eliminating them entirely. The study of the interests of forty-three identical and seventy-seven non-identical twins by Carter (*89*) increases the presumption of a hereditary factor of some sort underlying interest. His twin pairs of junior-high-school age or older were scored on the Strong Vocational Interest Blank for interest in twenty-three different occupations. The average coefficient of correlation for the fraternal twins was +.28, and for the identical twins it was +.50. After allowing for the effect of similar environmental influences upon twins and a possibly even greater similarity for identical twins, Carter expresses the opinion that "the greater similarity of environment is a far less important fact than the greater similarity of heredity."

One other sort of evidence may be mentioned that comes from Terman's investigation of gifted children. He studied the intensity of interest in the opposite sex on the part of boys and girls of different ages, and recorded a sudden and striking increase of boys' interest in girls at age thirteen to fourteen years. This change coincided with the onset of puberty and Terman attributed it to a hormonal influence. This, in turn, is attributed to the maturing of an organic mechanism that occurs independently of experience. A similar sudden change did not, however, appear in the interest of girls. Woodworth (*715*, 188) corroborates the observations of Terman as follows:

> We know from studies already made that play groups in early adolescence show a rather sudden shift of interest to dancing and other forms of companionship between the sexes—a shift that occurs about two years earlier in girls than in boys, in conformity with the earlier puberty of girls, and that seems therefore to depend on physiological factors.

If it be granted that there is some innate determiner of interest of the sort just discussed, there is still the necessity of accounting for the host of actual and, it may be, more superficial interests displayed by people in the course of their lives. One might inquire, for instance, how the shifting interests of the boy described by Fryer can be explained (see page 352). He provides a partial answer in terms of influential personalities. The boy looked up to his older brother from the time he was very young and was stimulated by him toward a systematic education. Later a college president stirred interest in the classics, a college professor aroused his interest in biology, and another professor,

together with the older brother, interested him in sociology. Here, then, is a powerful factor in the flowering of interest in the form of suggestion or prestige. It will doubtless be cited by the layman more frequently than any other cause of the choice of an occupation.

There is also the influence of mere force of habit and the impetus of a skill in generating interests. Here one comes upon Woodworth's (*710*) concept of a "mechanism becoming a drive," expressed so clearly in the following statement by Allport (*6*, 201):

> Over and over again it has been demonstrated that the skill learned for some external reason, turns into an interest, and is self-propelling, even though the original reason for pursuing it has been lost. A student who at first undertakes a field of study in college because it is prescribed, because it pleases his parents, or because it comes at a convenient hour, often ends by finding himself absorbed, perhaps for life, in the subject itself. He is not happy without it.

Suggestion, habit, and skill are only a few of the many factors determining the multitudinous play of interests over the period of a lifetime. Some of the influences are so fleeting and the interests that are generated so temporary that listing them would contribute nothing to a program of prediction. It should be noted, however, that there need be no conflict between the concept of native determiners of interests, fundamental drives, or motives and the more accidental and changing forces of habit, suggestion, and the like. All may and do contribute to the total pattern of an individual's interests.

RELATIONSHIP BETWEEN INTEREST AND ABILITY

The search for a relationship between interest and ability inspired some of the earliest studies of interest. Aside from the great theoretical significance of such a relationship, there was the hope that interest, still unmeasured, might be inferred from the presence of ability. At a later date, when interest itself began to succumb to measurement, there was the reverse hope that abilities, having been found so very difficult to measure, might be inferred from the presence of interests. Today, when both aspects of behavior are being actively measured, little effort is being directed to determining relationships.

General considerations of mental organization would lead one to expect a positive relationship. To quote from Woodworth (*710*, 74):

> As a matter of fact human interests keep pace with human capacities Almost always, where a child displays talent, he also displays interest... Along with capacity for music goes the musical interest; along with the capacity for handling numerical relations goes an interest in numbers; along with the capacity for mechanical devices goes the interest in mechanics; along with the capacity

for language goes the interest in learning to speak; and so on through the list of capacities, both those that are generally present in all men and those that are strong only in the exceptional individual.

The experimental studies of this relationship have tended on the whole to confirm this view. Thorndike (*620*) (*630*) found a relationship between one's opinion of his relative ability and his opinion of his relative interest in his studies in elementary school, in high school, and in college as indicated by a coefficient of correlation of +.89. Furthermore, he found a correlation of +.66 between elementary-school interests and ability in college work, suggesting the possibility at least of predicting ability in special lines of college work from interest in similar work of earlier years. Bridges and Dollinger (*58*) measured the relation between interest in college courses evaluated subjectively by ranking of courses, and grades made in these courses by 500 students. The correlation that they obtained was quite low, namely +.22, and led them to conclude that "a person's relative interests are an extraordinarily inaccurate symptom of his relative abilities." After an examination and reinterpretation of the data on which these conclusions rested, Thorndike (*618*) reported that, if certain errors were allowed for, the coefficient of correlation would rise from +.22 to about +.70, making these results comparable with his own, and giving a reasonable basis for prediction. Little has come from the pure laboratory studies (*244*) of this problem, mainly because of the difficulty of engendering any considerable range of interest in the laboratory tasks.

Fryer (*191*) (*194*) (*195*) obtained evidence concerning the degree to which the intelligence of the worker is suited to his work and also the degree to which this relationship would change if the worker were to shift to that occupation in which he expressed the most interest. He measured the intelligence of persons desiring a change of occupation, and checked this intelligence score against the distribution of intelligence within the occupation engaged in at the time, and also against the distribution for the occupation desired. He found that 53 per cent of his cases were maladjusted through having more intelligence than their jobs required and 7 per cent through having less, making a total maladjustment of 60 per cent. If now the desired jobs are considered instead of the jobs actually held, the maladjustment in the direction of too much intelligence drops to 36 per cent, and in the direction of too little intelligence rises to 15 per cent, making a total maladjustment of 51 per cent. The author rightly attaches no particular importance to the difference between these two totals, but points out the large size of the discrepancy in both cases. It is interesting to observe that to adopt the desired occupation would increase the number of cases of insufficient intelligence. This is, doubtless, merely the result of the desire to

better one's position rather than the result of a tendency to overrate capacity.

It is not an easy matter to extract the effect of interest from the other factors influencing the choice of occupation in this study. It is not known, for instance, to what extent any individual was in the occupation to which pure interest would have directed him, nor is it known whether interest in the desired occupation was anything more than a wish to make more money, to have shorter hours of work, or just to make a change. It is not such superficial interests as these that are assumed to be related to capacities.

The time is ripe to attack the problem of the correlation between interest and ability in a serious manner with the best available instruments for measuring each, with well-controlled conditions, and with groups of subjects large enough to engender confidence in the results. Until such time, one can assume a positive correlation, slight though it may be, on the basis of the expectation that in the long run desirable qualities tend to be positively correlated.

FUNDAMENTAL INTERESTS

The vocational psychologist is faced with the task of arriving at some feasible program of interest measurement, both for the purpose of predicting interests themselves and also of predicting probable occupational success from interests. Must he attempt to devise a test for every occupational interest no matter how specific it may be? Strong has already derived on his Vocational Interest Blank scores for thirty-two different occupations, but there are thousands of other kinds of work that could make an equally strong claim for consideration. The situation in regard to interest, however, is no worse and no better than it has been shown to be in the case of special abilities and character traits. There are thousands of special abilities and numberless special character traits. The effort that is being made in these last two fields to discover essential units or components in the total complex, and the significance of the findings for vocational psychology, have been reported in the two preceding chapters. A similar approach to the interest problem offers promising possibilities, and is being actively cultivated at present by several investigators.

The search for something innate in the pattern of interests has already suggested that some distinction be made between superficial and fundamental interests. No matter how strongly one believed in the innateness of interest, he would not argue for the presence of any determiner guiding a person to be a vacuum cleaner salesman or a bond salesman or an insurance salesman. These occupations are accidents

of our own specific culture and all three may conceivably disappear within a generation or two. What then are the really fundamental interests which tests of the sort above mentioned should attempt to measure? Some hint in this regard comes from the well-recognized distinction between interests in people and interests in things which are thought to be innate. But sharper evidence comes from a study of the trends of interests within individuals. Fryer (*192,* 5-14, 366-419) supplies a series of interest autobiographies which will repay careful study. He mentions the case of one individual who at an early age had pronounced mechanical interests, shown toward locks, guns, automobiles, and motorcycles, and who later took a course in mechanical engineering. This was followed by a period in which sports were the main interest, along with exploring, hunting, cycling, and traveling. There followed upon this an interest in music in the form of violin playing. Then an urge to help the world and to be of service to humanity seemed the dominant interest. This was succeeded at the age of thirty by a strong scientific interest in biology and social science, and this, in turn, was followed by an interest in linguistics and literature. Finally, committed to college teaching as a profession, he shifted from history to economic history and finally to economics. Fryer sees in this variegated pattern of interests one single and unitary drive for *social recognition.* The means chosen to attain such recognition comprised the superficial interests and were the consequences of many and fleeting environmental influences.

If one were to follow the clue provided by Fryer, he might finally arrive at the list of instincts of McDougall (*409*) as the bases of interests. Or if one were to lean toward psychoanalysis, he could find the foundation of all interests in hunger and love, the interests themselves being the consequences of the process of sublimation.

INTEREST INVENTORIES

A list of fundamental interests derived from an inventory of instincts or motives would vary according to the school to which the author belonged. The Allport-Vernon scale for the "Study of Values" (*84*) (*667*) is an interest test that is based upon the six fundamental value experiences of Spranger. They are the political, the economic, the aesthetic, the social, the theoretical, and the religious. Brainard (*57*) (*192,* 34-38) constructed an interest inventory for high-school and college students that comprises a series of twenty groups of activities each illustrated by five specific instances. The activity groups were set up from an observational analysis of behavior. Although the inventory aims at complete coverage of interests, it apparently does not

presume to represent a pattern of irreducible and fundamental interests. It will serve as a sample of a rather common type of catalogue. His list of twenty groups is:

1. Physical. Likes to do work involving bodily exertion.
2. Mechanical. Likes to construct or repair machinery.
3. Outdoor. Enjoys outdoor life.
4. Vocal Expression. Likes to talk to people, to argue or explain.
5. Drawing. Has interest in accurate reproduction of objects.
6. Leadership Prefers to lead rather than to follow
7. Social. Enjoys group activities, prefers not to work alone.
8. Order. Wants to have materials arranged systematically.
9. Literary. Has desire to express ideas in written articles.
10. Mathematics. Enjoys working with figures and symbols.
11. Aesthetic. Is appreciative of beauty and art.
12. Scientific. Interested in physical phenomena.
13. Fine Manual. Likes to use fingers in making adjustments.
14. Commercial. Likes to deal with people in business.
15. Skilled Manual. Likes to use hands.
16. Music. Enjoys all forms of musical expression and appreciation.
17. Study. Likes to dig into a subject and know all about it.
18. Experiment. Enjoys trying things and watching results.
19. Observation. Is interested in the way people or things act.
20. Creative Imagination. Pictures everything vividly in the mind.

Numerous simpler and broader lists have been proposed such as Terman's (*607*, Vol. I, 455-483) three types of interest used in the analysis of gifted children—intellectual, social, and activity interests—and the classification proposed for vocational purposes by Davies (*127*) comprising intellectual, practical, and social interests. None of these is entirely suitable for a vocational analysis of interest.

FACTOR ANALYSIS OF INTERESTS

From the standpoint of both theory and practice the application of factor analysis to the problem of fundamental interests seems most promising. Furthermore, it could provide the basis for interest patterns comparable to the ability and character-trait patterns elsewhere looked upon with favor. Thurstone (*640*) (*641*) has worked over the intercorrelations among the interests of eighteen different occupational groups, as measured by the Strong Interest Blank, and has discovered that all of these interests are reducible to four independent interest factors as follows: interest in science, interest in language, interest in people, and interest in business. It is possible from his findings to give the relative influence or weight or loading of each of these four factors in any occupation. This means that the factor-analysis tech-

nique will furnish interest patterns for any of the Strong occupational groups. These are shown in Table 46. The first column gives the occupational name, and the next four columns give the weight or loading for science, language, people, and business respectively. Those values have a maximal range from − 1.0 through zero to + 1.0, zero meaning absence of either like or dislike for a given factor in the occupation. The relative size will show the influence of the factor either

TABLE 46

RELATIVE INFLUENCE OF INTEREST FACTORS IN OCCUPATIONAL INTEREST *

Occupation	I *Science*	II *Language*	III *People*	IV *Business*	*Sum of Squares of Loadings*
Advertising	− 48	+ 66	− 21	+ 22	.76
Art	+ 45	+ 70	−.18	− 31	.82
Certified public accountant	−.04	+ 32	.00	+ 56	.42
Chemistry	+.98	− 21	−.15	+ 06	1.03
Engineering	+ 84	− 36	+ 22	+ 16	.91
Law	− 23	+ 77	− 12	+ 44	.85
Ministry	+ 09	+ 51	+ 62	−.30	.74
Psychology	+.77	+.47	− 04	−.28	.89
Teaching	+ 36	+ 15	+ 68	− 22	.66
Life insurance	−.82	− 02	+ 27	+.45	.95
Architecture	+.83	+.26	+ 16	+ 05	.78
Y.M C A. secretary	−.23	00	+.90	−.37	1.00
Agriculture	+.71	−.54	+ 01	+.18	.83
Purchasing agent	−.05	−.79	+ 01	+ 44	.82
Journalism	−.15	+.84	− 28	+.25	.87
Personnel	−.30	− 26	+ 66	−.19	.63
Real estate	−.76	−.07	−.06	+.58	.92
Medicine	+ 71	+ 33	−.26	− 09	.69

* Adapted from L. L. Thurstone, "A Multiple Factor Study of Vocational Interests," *Person. J.*, 1931-32, *10*, 201

in the positive or negative direction according to sign. Thus engineering is characterized by strong scientific interest, law by strong language interest, teaching by a strong interest in people, and real estate by a strong interest in business. The last column in the table indicates the degree to which the four factors account for the total interest in the profession. The maximal value is 1.0, hence it appears that whereas chemical interest is fully accounted for by these four factors, interest in certified public accountancy must have one or more other interest factors not identified in this analysis.

It should be observed that whereas the factor weights are determined

by statistical analysis, the identification of the four factors comes from an inspection of occupations and the weights assigned to them. The names which Thurstone has adopted conform with logic and common sense. This type of analysis makes it possible to define individual as well as occupational patterns, so that individual interest patterns can be fitted to occupational interest patterns for purposes of prediction.

Strong (*591*) has applied the Thurstone technique to twenty-four of his occupations with results which conform fairly closely with Thurstone's analysis of eighteen occupations. He finds evidence for a fifth possible interest factor, and suggests rightly that still other factors might be disclosed if a larger number of occupations were to be subjected to analysis. Strong makes use of his own and Thurstone's data to classify occupations into seven groups according to similarity of interests. When such groupings have been well established, it should be possible to classify an individual into one of the seven groups with little time and expense compared to the finer analysis in use at present.

DEVELOPMENT OF INTERESTS WITH AGE

Evidence of several sorts has already been presented that bears upon the matter of changes in interest as one grows older, becomes more mature, and accumulates experience. In so far as interests rest upon an innate foundation, there should be something stable about them. Even then certain ones might be expected to vary and perhaps even to come and go, as sex interest does, since the glandular functions with which they are correlated wax and wane. Interests could also be expected to change because any given innate determiner might have various modes of expression at different stages in a life history. Interest in social recognition that makes the young child want to be a policeman might make the adult want to be governor of his state. The dependence of interests upon the acquisition of habits and skills would lead to the expectation of some change in interest patterns with age. And, finally, to the extent to which valid expression of vocational interest depends upon vocational information, there should be a shift in the pattern of interests with increase in knowledge.

Such researches as there have been upon this question bear out these expectations. Differences in findings from one experiment to another can be explained on the basis of differences in the populations tested, in the methods employed, and in the interests sought for. Lehman and Witty (*372*) tabulated the interests of 7,000 school children, ranging in age from eight and one-half to eighteen and one-half years of age, who were asked to check their preference on a list of 200

occupations. Table 47 shows the frequency of interest in the occupation of cowboy for age groups eight and one-half to eighteen and one-half years. For boys, the frequency fell from 64 per cent at the earliest age to 4 per cent at the latest age. Other occupations showed extensive shifting though not so great as that of cowboy. Most of the other studies made previous to this one, and which are reviewed by Lehman and Witty, traced interest changes within the same individual, but

TABLE 47

CHANGE IN COWBOY INTEREST WITH AGE *

Age	*Number Boys*	*Per Cent Cowboy Interest*	*Number Girls*	*Per Cent Cowboy Interest*
8½	203	64	259	7
9½	349	64	358	5
10½	403	61	372	7
11½	387	49	375	3
12½	392	38	372	3
13½	365	38	346	4
14½	361	24	391	3
15½	324	14	322	3
16½	251	10	299	1
17½	162	5	156	2
18½	57	4	36	0

* Adapted from H. C. Lehman and P. A. Witty, "The Constancy of Vocational Interests," *Person. J.*, 1929, *8*, 259.

over periods ranging only from six months to several years, too short a time to afford evidence for vocational prediction. However, the majority of these, among them the work of Poull (*509*) and Franklin (*178*) emphasize the permanence of interests over the periods studied. Thorndike's (*620*) (*630*) research on permanence of interests, comprising a comparison of current interests with retrospective reports of interests at earlier periods, showed a surprising degree of permanence. In one set of comparisons the average correlation between elementary and high-school interest was +.85, between elementary school and college +.66, and between high school and college +.79. Critics have tended to minimize these relationships on the ground of possible confusion between memories for various life periods and of the narrow range of choice of interests which was limited to the subjects studied in school.

The more recent evidence is derived from the use of standardized interest tests (*590*) and concerns the range of ages that are most vital for vocational adjustment. Strong (*597*) compared the occupational-interest scores of 223 persons tested when they were college seniors

and again five years later. He obtained a correlation coefficient for each of twenty-three different occupations. These coefficients vary from +.59 to +.84 and average +.75. When corrected for attenuation, this average rises to + 84 Strong thus discloses a surprising constancy of interests among college graduates in the five-year period from twenty-two to twenty-seven years of age.

Strong (*594*) fails to find the same level of stability during the years from the age of fifteen to that of twenty-five, a critical period, indeed, since within its limits most vocational careers are chosen. He says:

> It now appears that there is a noticeable change in interests during the decade from fifteen to twenty-five years There is about the same amount of change between fifteen and twenty years as between twenty and fifty-five years; there is also about the same amount of change between twenty and thirty years as between thirty and fifty-five years.

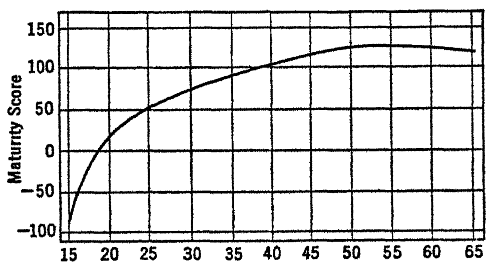
He (*597*) attributes the interest vacillation during this period to

> ...the development during later adolescence of interests which are seemingly largely sublimations of the parental instinct Although there are these changes, nevertheless interest patterns are really surprisingly stable from fifteen years of age on.

What this statement means is that although compared with the change during the years of maturity the changes from fifteen to twenty-five are large, the latter are really small because the later years are so very stable. His reference to the "parental instinct" furnishes another instance of belief in the dependence of interests upon the maturing of organic and behavior mechanisms.

FIGURE 73

INTEREST-MATURITY SCORE *



* Adapted from E. K. Strong, "Interest Maturity," *Person. J*, 1933, *12*, 86.

Strong (*594*) has recently developed an interest-maturity score that expresses the degree to which the pattern of occupational interests at any age approximates the pattern of successful men of fifty-five years of age representing "as wide a variety of occupational interests as possible." It is not feasible to describe here the technique by which the maturity score is derived, but inspection of the smoothed curve in Figure 73 will give some notion of the changes in this score that accompany changes in information, experience, and outlook on life as age increases. The maturity scale is shown on the left. It varies from — 100 through zero

to + 150. The portion of the curve below zero, which lies in the neighborhood of eighteen years, indicates a trend toward dislike of what is liked at fifty-five years, zero means neither like nor dislike, and plus means trend toward similarity in likes.

What is, perhaps, the most promising note in the trend of interest measurement comes from the discovery reported earlier that occupations can be grouped into a few classes on the basis of similarity of interests, whereby Strong can say (*594*, 90):

> Apparently the fifteen-year-old boy has to a large degree the fundamental interests characteristic of most occupations, except those related to ministers, school men, city school superintendents, Y M.C.A. secretaries, personnel managers, and to a lesser degree psychologists, certified public accountants, journalists, and lawyers.

It seems probable that all persons fifteen years of age or older can some day be assigned to one of four or five interest categories, and that such classification will show a high degree of stability from fifteen years to old age.

19

Adjustment of the Individual at Work

The problems of adjustment have not all been solved when the individual has been guided into or selected for some specific vocation, no matter how faithfully his general capacity, his special aptitudes, his personal characteristics, and his interests have been gauged. He must be adjusted within his work, to his surroundings, his fellow workers, his supervisors, his tools and materials. Traditionally such matters as these comprise industrial psychology.

THE GOAL OF ADJUSTMENT

It is necessary at the outset of any discussion of adjustment in work to define the goal of such adjustment. What does it mean to be adjusted? Although it might possibly have been acceptable a generation ago to reply that it meant getting work done or getting the most work done, no psychologist today would accept such a simple interpretation of the problem. Perhaps a final answer can only evolve out of the growth of a social philosophy.

Doob (*143*) has shown clearly and dramatically how difficult and treacherous is the course that will have to be traversed in planning an adequate adjustment for the individual and for society. But, in the meantime, the applied psychologist can detect trends and erect tentative goals in accordance with them. One such ultimate goal was cited on page 2 wherein, according to Kelley, "We seek a mode of individual functioning which gives the dual return of satisfaction and welfare to the individual and goods and attitudes of value to society." More narrowly, the vocational counselor (*571*) defines his goal as leading to successful living which "is achieved by those who live at the optimum of their potentialities—but with a minimum of emotional or mental 'load.'" Both statements imply the desirability of increasing the dignity, the integrity, and the satisfaction of the individual while he produces goods useful to society.

The one fact that stands out most conspicuously in the midst of

our rapidly changing social and industrial structure is just this increasing emphasis upon the welfare of the individual. The applied psychologist occupies a strategic position in this whole development since he is trained to attack the problem of adjustment in the light of a knowledge of individuality and individual differences. As an observer of the industrial scene he sees many conflicts in trends, shifts in attitudes, and incompatibilities within programs as one or another of the goals of adjustment receives more or less emphasis. Thus in a discussion of industrial conflict (*247*, 16) one reads:

> The presupposition that industry should be run for profit conflicts with the assumption that industrial development should be planned for the well-being of the worker; the traditional goal of smooth administration may conflict with the assumption that management has responsibilities for the health, content, and security of workers; the assumption that production should be as efficient as possible may conflict with the theory that machines should serve man's needs and that if increasing efficiency in production means fewer jobs and prolonged unemployment, then that type of efficiency must be changed or used as an instrument in a different social context.

However difficult it may be, an attempt must be made to put together into one pattern of adjustment all of the components, each in its proper place and with the relative emphasis which it deserves. The pattern cannot be a fixed and final one but will be subject to modification as enlightenment grows. A trend in the direction of the proper ultimate goal is as much as can be hoped for.

CONCEPTS OF EFFICIENCY

It is the purpose of this chapter to examine in the light of psychological knowledge the current concepts of efficiency, to appraise them from the psychological point of view, and to propose a definition that shall be psychologically acceptable. A formal definition is as follows (*153*, 4):

> Efficiency is the property of producing results in excess of expenditures.... The degree of efficiency of a process is the ratio of the available result of the process to the expenditure.

A simple means of defining the efficiency of an operation, of an industrial plant, or even of a whole industry is to set up a fraction in which the numerator represents a unit of output, and the denominator represents a unit of cost. The larger the numerator is in relation to the denominator the greater the degree of efficiency. Thus if a farmer receives $1,500 for a crop which cost him $1,000 to raise, the degree of efficiency would be $\frac{3}{2}$. When the fraction falls below unity the result

is a loss or the operation is a waste, as in the case where a crop costing $1,500 to raise would be sold for $1,000 (degree of efficiency ⅔). The term *efficiency* as customarily used means *degree of efficiency* as just defined. Difficulties arise when one attempts to specify what items shall be included in the numerator and the denominator of the fraction. In the production of things such as automobile radiator caps, the output unit would, of course, be one cap. The unit of expenditure or cost, on the other hand, would include a charge for raw material, for power, for general depreciation of equipment, for overhead (supervision, management, rent, and so forth), and for wages, to mention only the most obvious. In this simple scheme the worker appears directly only in terms of the fraction of his wages, or the fraction of his time consumed in the production of the object. Very recently also the worker has come to be further represented in the denominator through charges for old-age insurance and unemployment insurance.

HUMAN EFFICIENCY

A thorough examination of the human factor in the work situation discloses the fact that it is frequently the costliest item in the whole efficiency equation, even though it appears as only one of the many items in cost. This discovery has focused attention upon the increase of efficiency of the human machine. Such a shift of emphasis implies the complete reorganization of industry, in equipment as well as in point of view. Instead of the individual's being fitted into a routine of work, the routine must be modified to conform to the needs of the individual. In the course of this transformation, which has been taking place gradually and is by no means complete, there is a tendency to carry over the mechanical conception of efficiency to the interpretation of human behavior. Although, in general outline, the definition is the same in both cases, the individual items to be included in output and expenditure are not identical. Neglect of one or more items, either of output or expenditure, will upset the equation.

On the side of output, results of human work can be computed in terms of units of work done, much as in the case of a purely mechanical operation. In computing expenditure, however, serious difficulties are encountered. In the case of a machine the general depreciation or wear and tear to be charged per unit of output can be readily computed by knowing the lifetime of the machine, its cost, and the number of units it can be expected to turn out while in service. In the case of the human individual, no one has had the temerity to make such calculations in terms of dollars and cents. Yet the human wear and tear differs considerably with the occupation, if the length of the working

life is considered, if work hazards in terms of sickness, accident, and death rate are taken into account, and if cost of insurance is accepted as an indication. Some note of job differences in these respects is taken in the adjustment of wages to working conditions, but what an equable differential rate should be no one knows. How could one proceed to compute the depreciation value to be charged against one hour of work in the case of a day laborer, a skilled workman, a business executive, or a lawyer? Whether there should even be a differential charge for an hour of life in different occupations would be an interesting question for debate. To fail, however, to take some account of this factor in computing the cost of work is an error that may manifest itself in dissatisfaction in industry.

HUMAN ENERGY EXPENDITURE

A far more obvious item of cost than that for human depreciation is the energy expended by the human machine in doing a unit of work. In spite of the analogy with a mechanical device in this respect, little attention has been paid to this factor either by the engineer or by the psychologist. To be sure, some measurements have been made in recent years of the human energy cost of various methods of working, but they have largely remained as laboratory curiosities. Certain of these studies will be discussed in Chapter 23. The neglect of the energy cost has been due in part to the fact that under ordinary circumstances the worker replenishes his energy by way of his three meals per day and his night's sleep and in part to the fact that the energy consumed has seemed to be negligible. Periods of high pressure for increased output as in war, calling for a long working day and a long working week, have shown very clearly that the energy expended is not negligible, that some methods of work use more energy than others, and that the latter portion of a long work period consumes more energy per unit of output than an earlier portion.

There is one assumption that is responsible above all others for the neglect of the energy component in the equation of human efficiency, namely the assumption that a worker spends his energy at a fixed and uniform rate. If such were the case, that is, if energy expenditure were a fixed quantity or a *constant*, efficiency could be computed in terms of output alone. Thus one method of work giving ten units of production at a given cost per unit would be more efficient than five units at the same cost per unit. It has, consequently, been customary to compare the efficiency of various programs solely in terms of differences in output, and even to measure so-called fatigue in terms of decrement of output.

The psychologist in his measurement of the efficiency of various methods of work—as in comparing methods of learning, recalling, and recognizing, of acquiring skills, and of solving problems—saw the significance of differences in energy or effort, but evaded their measurement. This he did by assuming that the factor of effort could be held constant by his instructions to the subject to do his best, or work at his maximum. The further assumption that one's best or one's maximum is a fixed and unchanging quantity enables the psychologist to make a great variety of comparisons of work methods and working conditions in terms of output alone.

Numerous studies beginning with that of Morgan (*437*), who measured the efficiency of work under the distraction of a noise, have shown that such an assumption is false, that "doing one's best" is a variable and the energy expended in doing it depends upon the nature of the task, the surrounding conditions, how long the work has been in progress, and the satisfaction derived. Many current beliefs about the relative efficiency of various methods of work and of work conditions demand reconsideration. As to the efficiency of working long hours rather than short hours, of working under strong incentives, under conditions of monotony, under extremes of temperature and humidity, the real answer is yet to be found. Some of these important matters have been discussed in earlier chapters and others will be dealt with in succeeding chapters.

NEED FOR SATISFACTION

There is one factor in human efficiency that does not appear at all in the definition of mechanical efficiency, namely the provision on the output side of the equation for satisfaction in work. Whatever the nature of one's philosophy of life may be, it would seem that the worker is entitled to a certain minimum of satisfaction as a part of the product of his work. The goals of adjustment for successful living emphasize this factor, as the earlier sections of this chapter clearly showed. Satisfaction thus conceived is entirely independent of the satisfaction that is sometimes provided for merely as a means of stimulating output.

Occupations differ strikingly in the amount of such pure satisfaction that they give. Recent surveys (*247*, 114-124) have shown that workers in some occupations get more enjoyment while at work than they do in the hours spent away from work. Contributing to such satisfaction are good relations with one's boss, understanding and appreciation on the part of superiors, good physical working conditions, sympathetic counsel on personal problems, congenial contacts with fellow workers, and a reasonable degree of job security. These are only a

few of the many factors that have been discovered, and that compare favorably in importance with hours of work and wages in the mind of the worker. Many of them can be provided at little or no cost at all, once their importance is recognized.

DEFINITION OF HUMAN EFFICIENCY

In spite of the difficulties to be met in measuring human efficiency, at least a tentative definition of it will serve as a guide for the study of problems in the psychology of work. The ideal of human efficiency would be *the production of the maximal output of the highest quality in the shortest time, with the least expenditure of energy and with the maximum of satisfaction.* Emphasis upon different aspects of this definition leads to varying results. Management has emphasized the quantity and quality of output; labor has emphasized the decrease in expenditure of energy. No one has, consciously at least, attached to satisfaction from work the importance it deserves in the conception of efficiency. It will be evident that these three phases of efficiency are not unrelated. Conditions influencing one phase will affect the others. Still, from the psychological point of view, they can be dealt with separately to advantage.

AN INDUSTRIAL EFFICIENCY SYSTEM

It will be helpful, in applying this concept of efficiency in a critical examination of work methods, to inspect a well-known efficiency program. The most appropriate one for our purpose is the Gilbreth (*211*) system, since it embodies much that is psychologically sound.

Gilbreth proposed nine principles of efficiency which may, for purposes of psychological examination, be reorganized into five, namely, individualization, specialization (or functionalization), standardization, incentives, and welfare. The remaining four, measurement, analysis and synthesis, records and programs, and teaching are here combined with standardization, because they are all component functions within the standardizing process.

The first of these principles, *individualization,* rests upon the established fact of the *uniqueness of the individual.* Under the traditional forms of management, the "gang" had been the unit of operation. There had been little effort made to select or adapt the individual to a task according to his peculiar fitness. But the same need for recognition of the individual that has revolutionized education was observed to have its application to industry. Gilbreth wrote (*211, 27*):

Under scientific management the individual is the unit to be measured. Functionalization is based upon utilizing the particular powers and special abilities of each man. Measurement is of the individual man and his work. Analysis and synthesis build up methods by which the individual can best do his work. Standards are of the work of an individual, a standard man, and the task is always for an individual, being that percentage of the standard man's task that the particular individual can do. Records are of individuals and are made in order to show and reward individual effort. Specific individuals are taught those things that they individually require. Incentives are individual, both in the case of rewards and punishments, and finally, it is the welfare of the individual worker that is considered without the sacrifice of any for the good of the whole.

Along with this discovery of the individual there goes the recognition of his importance, and the need for adjusting every detail of the work situation to him, instead of forcing him to fit into the set pattern of industry. For instance, Gilbreth and Gilbreth (*207*, 93) say in regard to fitting chairs to the individual:

Very few people realize that the working girl should be measured for her working chair in which she spends one half of the time that she is awake during her entire working life. For this purpose we have had test chairs of varying heights made for the girls to sit in, and then have made a chair for each girl, particularly adapted to her and her work. The correct height of chair is determined much quicker and fits much more accurately than does an adjustable chair.

The recognition of the individual implies not merely the adjustment of chairs to fit anatomical structure but the adjustment of the position of levers, the distance and direction in which they are to be moved, the part of the body that is to move them, the location of the supply of raw material, and of the place for finished parts. These and numerous other details must be studied in order to make the most of the human factor in production. More fundamental still is the recognition of the individual worker as a factor in management; he might have a voice in determining the general policies governing hours of work, methods of remuneration, selection of foremen, and he might be a joint owner of the enterprise through the purchase of stock or through some system of profit sharing.

Nothing further needs to be said about individualization at this point since the fact of individual differences permeates the whole book. A chapter will be devoted to each of the other four principles so that only a few statements about each will be given in this connection. *Functionalization,* or *specialization,* refers to the limitation of the range and variety of duties that each individual performs. It will be recognized as one of the most spectacular characteristics of modern industry and business. One sees it at its extreme, perhaps, in the assembly lines of the automobile industry, but it is everywhere prevalent, in clerical

work, in selling, in administrative work, and in the professions. It deserves careful psychological analysis if for no other reason than that it tends to run counter to the principle of individuality.

Standardization of the work program when carried to the limit prescribes for the individual, among other things, definite and fixed sequences of reactions. These sequences are derived from an elaborate study of the task, are recorded, and are transmitted to the worker in a systematic course of instruction. He cannot depart in any respect from this predetermined course of action. Along with this standardized procedure there goes a commendable attempt to establish the correct physical relations between the worker and his tools and equipment. It will be obvious, however, that such standardization reduces the freedom of the individual to choose his actions according to his own comfort, preferred rhythms, and need for rest, and thus conflicts with the concept of individuality.

Most interesting of all these principles from the psychological point of view is the principle of *incentive*. It is a device that is deliberately employed as a spur to activity, and to make the individual willing and ready to accept standardized procedures that might otherwise be distasteful to him. Its use implies a recognition of the fact that individuality and standardization are to a certain degree in conflict. The understanding of its proper use and the consequences of its use offer an interesting challenge to the applied psychologist.

The principle of *welfare* covers a great variety of means that may be employed to increase the satisfyingness of work. It calls for the provision of conveniences and comforts on the job, of aids to a sense of well-being and security for oneself and one's family in the home, and of the means of healthful recreation and entertainment during intervals between work periods, at the end of a day, during holidays and vacations. The psychological implications of these many devices for increasing work and satisfaction are numerous and deserve careful examination. In Chapter 24 an effort will be made to discover the psychological factors underlying their use.

Conflict of this principle with that of individualization is not so apparent, but upon close observation it will be found. Any encroachment upon the freedom of the individual that even suggests regimentation is likely to be distasteful and annoying. It is particularly so when it concerns what one shall eat for his lunch, what his recreations shall be, when he shall take them, where he shall live and what kind of insurance he shall carry. Some light on what welfare programs are good and when and how they shall be administered may be expected to come from a study of the mechanism of satisfaction and the conditions that tend to raise and lower it.

20

Adjustment to Uniformity and Variety of Work: Specialization

The trend toward greater and greater specialization in the performance of the world's work can be noted on every hand. Some limitation of function has had to occur for, with the expansion of knowledge and the increase in the variety of skills, one person can no longer be expected to be a "jack of all trades." This general trend has met with no resistance and with relatively little comment except in isolated instances. The high degree of specialization within certain of the professions, particularly the medical profession, has aroused criticism because the change finally affected both the sense of security and the pocketbook of the patient. Less has been said about the effect upon the practitioner, although the implication would be that that effect would be a favorable one. The adoption of specialization in the skilled, semi-skilled, and unskilled occupations, and the extreme to which it has been carried in certain industries, has clearly raised the question as to the real efficiency of the change, and how any ill effects, if disclosed, can be counteracted.

The war emergency promises to extend and intensify the trend toward limitation of function. The search for bottlenecks in industrial production and for the causes of these has disclosed a shortage of skilled workers. The most serious deficiency is found in those occupations where the training period is the longest. A logical remedy, and the one that is being applied, consists in breaking down the skilled jobs into smaller and smaller units, with the result that the learning time will be days, weeks, or months instead of years. As pressure increases still further, even finer subdivision of skill will be adopted so that training can be given in the shortest possible time. What will be the results, psychologically and physically, of this strict limitation of function in occupations that had previously experienced so little of it? This chapter will undertake an analysis of the psychological factors involved in such specialization.

SPECIALIZATION IN EVERYDAY LIFE

The reader can readily find cases within his own daily life where specialization of function could be or has been adopted. Housecleaning has been shown by actual trial to move more expeditiously if one first sweeps all rooms, then dusts all rooms, then polishes all furniture, then arranges all contents, than by the more commonly observed method of sweeping a room, then shifting to the task and tools of dusting, then polishing, then arranging, and then repeating this series of shifts for each room. Dishwashing obviously proceeds more efficiently when the collecting task, then the scraping task, then the washing task, then the drying, and then the replacing are each continuously maintained. Similarly in constructing even such simple objects as window screens, it is more effective to do all the sawing first, then all planing, then all sandpapering, then all joining, then all screen cutting, then all stretching and tacking, then all finishing and trimming, and finally all painting, than it is to make each screen complete, changing from set to set, task to task, tool to tool, and place to place for each case.

The student has a good opportunity to observe degrees of specialization in the distribution of his own time, as he passes from a college program with several different classes per day on different subjects for each of which he must make specific preparation, to a graduate school where he may have in a week only as many classes as he was accustomed to in a single day. In the former case he may have to organize his time and his ideas in units of an hour, whereas in the latter he can concentrate on one subject for a day or more at a time. Or even while in college he may be asked to shift from a daily program of many classes to a reading period of two or more weeks when he will be expected to concentrate upon a single field or even upon a single topic within a field.

TWO KINDS OF SPECIALIZATION

A comparison among the various illustrations just given will show that the specializing of functions may proceed in either one of two ways, the psychological and physical consequences of which may not necessarily be the same. One kind of limitation consists in doing *one kind of job* continuously instead of two, three, or more in succession, and the other consists in the *simplification of the given job,* with a smaller variety of movements, tools, or parts to be manipulated. An excellent illustration of the first comes from Stakhanoff's (*578*) report of the changes in mining operations in Russia introducing an industrial system known as "Stakhanoffism." The day's work was traditionally divided into three shifts. In the first a worker mined coal, in the second he erected props to support the roof of the excavated

section, and in the third he made repairs such as moving pipe lines, carrying wood for props, and cleaning up the work place. The revised system called for a miner to mine coal throughout the three shifts, while other workers specialized in propping or on repairs. Astonishing results were reported, among them more than 100 per cent increase in coal mined, with decreased fatigue and increased satisfaction.

An example of the second kind of limitation of function may be taken from the realm of mental work where an intelligence examination lasting fifty minutes will require the subject to perform hundreds of different mental operations, whereas an addition test would require that the whole time be spent in the process of adding. A more extreme specialization of this sort is described by the Gilbreths (*210*, 42).

> In laying brick, the motions used in laying a single brick were reduced from eighteen to five—with an increase in output from one hundred and twenty bricks an hour to three hundred and fifty an hour and with a reduction in the resulting fatigue. In folding cotton cloth, twenty to thirty motions were reduced to ten or twelve, with the result that instead of one hundred and fifty dozen pieces of cloth, four hundred dozen were folded, with no added fatigue. The motions of a girl putting paper on boxes of shoe polish were studied Her methods were changed only slightly, and where she had been doing twenty-four boxes in forty seconds, she did twenty-four in twenty seconds, with less effort.

The inference might be drawn from the observations of workers and from the casual measurements of investigators that every shift in the direction of uniformity and simplification of work will have a favorable effect. There are a number of reasons why such a conclusion cannot be accepted without a careful analysis of the problem. In addition to the qualitative nature of the evidence in most instances, an important reason for caution resides in the fact that whatever data there are available come from the measurement of production only, to the neglect of other essential factors in efficient work. If the definition of efficiency proposed in the preceding chapter is accepted, it will be necessary to measure both the *cost* of specialized operations and the *satisfaction* resulting therefrom and to include these in the final computation of efficiency. The evidence that can be adduced on these points is meager and frequently inadequate, but assembling it for inspection will at least point the way toward more valid conclusions.

A PSYCHOLOGICAL INTERPRETATION OF SPECIALIZATION

A psychological analysis of the processes involved in highly specialized work would direct attention at once to habit as a determining factor. The experience of an observing layman will tell him that he gets the habit of doing certain things and doing them in a specific way and

that to adopt a new pattern of action meets with resistance. He will note, though, that he can break old habits and establish new ones.

Analysis, however, has gone farther than this. There is assumed to be a factor in the organization of behavior called *perseveration* (*573*, 291-307), a tendency for mental processes to have a certain lag or inertia, one of the criteria for which is stated by Lankes (*362*) to be "the continuance, subconscious or even completely unconscious and purely physiological, of the effect of a past experience" shown by "the degree of hindrance which the perseverating effect of a past mental activity causes to a new one of the same kind." Spearman (*573*, 305-306) comments, significantly for our purpose, that it would seem that the perseveration produces interference only in special cases Interference occurs when the antecedent and the subsequent activities are mutually conflicting; for example, the writing of an *S* in the usual way conflicts with writing it mirror-wise. It occurs also when each of two activities covers a very extensive field, so that to switch from the one over to the other becomes a correspondingly elaborate operation; this probably occurs when a child shifts from lesson to lesson.

More closely allied to the practical problems with which this chapter is concerned is the concept of "mental set and shift." This concept rests upon the facts of habit, of preparatory adjustment for an act, and of perseveration on the one hand and upon the fact of adaptability of the human organism on the other. The latter is no less important in the general pattern of behavior mechanisms than the former. It is the inter-relationship of these two sets of facts, and their relative degrees of influence in specific situations, rather than the presence or absence of one or the other that affects efficiency.

The reader can experience the "feel" of shifting and get a crude measure of the efficiency aspects of it by performing a very simple experiment with the following series of fifty two-place numbers:

64	33	72	69
49	38	35	37
62	28	51	39
57	65	30	32
68	41	56	59
74	50	44	31
53	42	36	60
67	58	73	48
25	52	63	54
40	70	47	46
61	26	43	55
71	34	66	27
45			29

First add 17 to each of these numbers and then subtract 17 from each of them. Finally add 17 to the first, subtract 17 from the second, add

17 to the third, subtract 17 from the fourth and continue this alternation of task through the list. Quite uniformly it will be found that the mixed series seems more difficult to do, and measurement of the time required will show that it actually takes longer. If the time required for addition and for subtraction be averaged and this average compared with the time required for the mixed series, the difference will be the result of the shifting of function, since the operations are the same in all other respects.

SINGLE VERSUS MULTIPLE TASKS

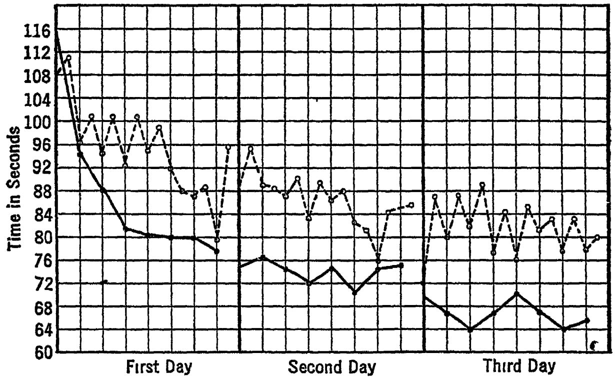
Culler (*123*) has furnished experimental evidence concerning the effect of limitation of function to a single task. He measured the time lost as a result of the interference created by the shifting from one type of task to another. Four groups of persons sorted packs of eighty cards, numbered from 1 to 10, into boxes each divided into ten compartments, also marked with the numbers 1 to 10 Two boxes with the compartments differently marked furnished two entirely different sorting arrangements, or codes. The sorting schedules for the four groups of persons were as follows:

Group I sorted eight times per day for six days using always the same code.
Group II sorted sixteen times per day for six days, alternating the two codes.
Group III sorted sixteen times per day for six days changing the code every four sortings.
Group IV sorted sixteen times per day for six days changing the code every eight sortings.

Thus Group I did not shift its operations at all, except whatever shifting was involved in the sorting within one code; Group II shifted fifteen times per day; Group III shifted three times per day; and Group IV shifted only once a day. All groups, therefore, sorted the cards according to one code eight times per day. The only difference among the groups (assuming their equivalence at the beginning of the experiment) is in the introduction of the second code, hence the effect of the shifting can be determined by comparing the second, third, and fourth groups with the first one in regard to the sorting of the first code. Figure 74 gives the average records of the male subjects for the sorting by Groups I and II. The solid line indicates Group I with no change of code, and the dotted line indicates Group II with the codes alternating. The records of the other two groups are omitted in order to simplify the chart. The vertical scale gives the time in seconds required for sorting the pack of cards and the horizontal scale gives the days and the different sortings per day. In the alternate sortings the first code nearly always gave the faster rate. The curves show clearly that the group that did the shifting always lagged behind the one that did not shift, even

FIGURE 74

THE EFFECT OF SHIFTING THE TASK UPON PERFORMANCE *



* Adapted from A J Culler, "Interference and Adaptability," *Arch Psychol.* (New York), 1912, No 24, 31-50

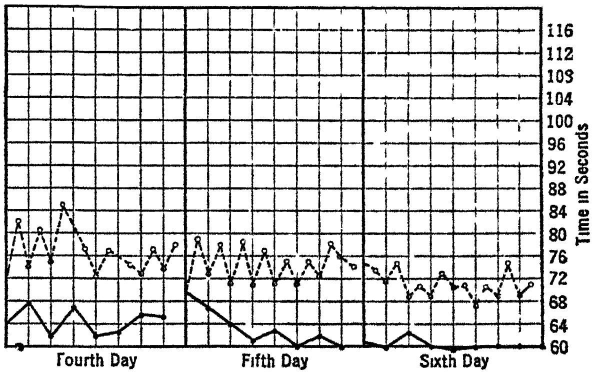
after six days of training. The difference is almost as great at the end of the training as at the beginning, which means that, when shifts are frequent, training does not eliminate the interference and loss of time. Both groups appear to have just about reached their limit of improvement so that it is not likely that a longer period of training would have changed the result. Culler's (*123, 72*) conclusion is, however, contradictory to this when he says, "The interference is, therefore, continually becoming less as related to the practice and if the experiment were carried on for a very long time, the two would undoubtedly come together."

In this experiment, the actual amount of physical distance covered in any one sorting is always the same as in every other sorting. In those industrial operations where the shift involves movement over greater distances—what might be called a spatial shift—there is even less likelihood that the delay due to shifting could be eradicated by training.

Although this principle of the maintenance of set or specialization of function has many important applications, it is scarcely necessary to point out that it should be applied, not blindly and inflexibly, but always with due regard for the circumstances and for other principles which may be equally important. Thus, to return to the case of the window screens, it would be a mistake to insist on doing first all screen stretching and then all tacking, since the tools required are the same in both cases and since such shifting would require complete rehandling of every screen. Moreover, such simple facts as that monotony and lack of variety in one's occupation may make for inattention, mind-wandering, accident, and ennui, thus incapacitating the worker, cannot be ignored. The experiment of Culler just quoted furnishes at

FIGURE 74—(*Continued*)

THE EFFECT OF SHIFTING THE TASK UPON PERFORMANCE



least a hint that certain large shifts may be beneficial and make for more rapid improvement. If the sorting records on the *sixth day* for the different groups be compared, it appears that Group IV, with only one shift per day, made a better record than any of the others including Group I which had no shifts at all. Groups II and III made records intermediate between I and IV. These data are given in Table 48. The figures are in terms of seconds required for the sorting. In every

TABLE 48

INFLUENCE OF VARIOUS SHIFTS UPON SPEED OF SORTING (LAST DAY) *

Roman Type Signifies Code 1, Italic, Code 2

Sorting No	*Group I*	*Group II*	*Group III*	*Group IV*
1..........	60 7	74 7	67 0	66 0
2......	.	*73 3*	61 0	61 7
3	58 3	72 0	62 9	59 7
4............	...	*75 3*	60 3	60.7
5...........	62 7	69 0	79 3	54 0
6...........		*71 0*	*69 4*	55 0
7.........	60 5	69 3	64 6	55 0
8............	...	*72 3*	*62 0*	55 0
9............	57 3	71 0	82.6	*71 7*
10............	. .	*71 3*	70 9	*66 0*
11	59 5	67 3	67 0	*67 7*
12............	...	*71 3*	63 6	*63 0*
13............	60 3	69 7	*80 9*	*60 0*
14............	. .	*75 0*	*69.3*	*56 3*
15............	60 3	69 3	*66 3*	*58 0*
16...........	. .	*71 0*	*63 0*	*54 0*

* Adapted from A J Culler, "Interference and Adaptability," *Arch Psychol* (New York), 1912, No 24, 31-50

case the record for the second code is in italics. The average times for sorting the first code on the sixth day are for the different groups as follows: Group I, 60.0 seconds; Group II, 69.4 seconds; Group III, 67.4 seconds; and Group IV, 58.4 seconds.

SIMPLICITY VERSUS VARIETY WITHIN A TASK

Jersild's (*322*) research on "mental set and shift" furnishes a comparison of the effect upon performance of simplicity and variety within the task itself, or of the degree of shifting within the task. This is in contrast to the study of Culler which was concerned with shifting from one task to another. Jersild has clearly demonstrated the complicated nature of the shift-set phenomena, some of the conditions that determine the efficiency or inefficiency of shifting, and the relation of ease of shifting to intelligence.

It is clear from the situations that Jersild has studied that a certain amount of shifting is inherent in practically every laboratory task as well as in the simple activities of everyday life. The consequence of this fact is that when a shift of tasks is introduced, the change is merely one of amount or degree of shift. Thus in the adding of seventeen to each of a series of numbers, there is a shift called for with each new number, not different in kind from that which occurs in the alternation between adding and subtracting. Likewise in the sortings of Culler, each successive card required a shift, not different in kind though certainly in degree from that of passing from one sorting box to another.

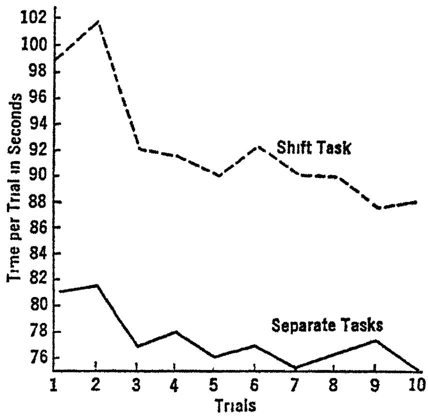
Jersild has demonstrated that one can get set, so to speak, for a task which contains within it a number of shiftings. In fact, such would seem to be the normal experience. Münsterberg (*441*, 69-88), in his frequently cited experiment of shifting his watch from one pocket to another and noting the errors made before adjustment to the new location occurred, demonstrated the same thing. He found that in time he could establish a set within which three locations of his watch could be reacted to without error. Jersild called such complex adjustments a *hierarchy of sets.*

It has been shown to be entirely feasible to learn to typewrite on two different kinds of keyboard so that whenever one sits before either kind he will react appropriately. In the same way, one can learn two systems of shorthand writing so that he can shift from one to another with ease. Perhaps the most familiar instance of all is the ability of some persons to speak without confusion in any one of four or five different languages as the particular situation demands. How complex such sets or adjustments can become without the onset

of frustration there is no experimental evidence to show. What is still less understood is the efficiency of such complex sets, computed in terms of the time and effort required to establish them in contrast to the simpler adjustments. In industrial tasks this is a problem warranting careful investigation.

FIGURE 75

SET AND SHIFT IN FORM-NAMING AND SUBSTITUTION—TWENTY-TWO SUBJECTS *

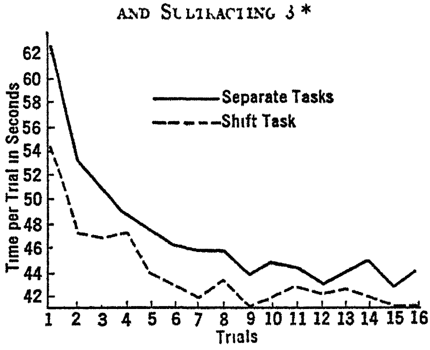


* From A T Jersild, "Mental Set and Shift," *Arch Psychol* (New York), 1927, No. 89, 55

Jersild showed that, whereas shifting within a given task may be inefficient in terms of time spent per unit of work under one set of circumstances, under other circumstances it may be more efficient than the simpler task. Thus, the naming of a series of one hundred geometrical forms, or the substitution of a code number for each of these geometrical forms can be accomplished much more quickly than the more complicated task of naming the first form, substituting a code number for the second, naming the third, and so on throughout the whole series. The results of ten successive trials of each of these tasks are given in Figure 75. The ten trials are shown along the base line and time per one hundred items (or per trial) is shown on the vertical scale. The solid line represents the average time for the simple task of naming or coding, whereas the broken line represents the alternating task. The loss from shifting is very great, and at the end of ten trials is still large, although the difference between the two tasks is less at the end than at the beginning.

FIGURE 76

SET AND SHIFT IN NAMING OPPOSITES AND SUBTRACTING 3 *



* From A T Jersild, "Mental Set and Shift," *Arch Psychol* (New York), 1927, No 89, 51

This case contrasts sharply with that demonstrated in Figure 76. Here the simpler task consisted in naming the opposite of each of

a series of twenty-five words, or of subtracting the number three from each of a series of twenty-five two-place numbers. The complex task consisted of alternation between the naming of opposites and the subtraction of three. At every trial the *varied* task was performed more quickly than the *simpler* tasks. At the end of sixteen repetitions the difference in time is still present although not so great as at the beginning of the series.

Interference might be expected from a casual observation of the performance shown in Figure 75, in which the same set of symbols, the geometrical forms, call alternately for naming and for attaching code numbers. A set or tendency to bring a name to mind must be inhibited and an appropriate number must be called. In such a case one can literally "feel" the shifting. Since the operations involved in the process shown in Figure 76 are entirely unlike each other, the one naming opposites and the other subtracting three, no interference need, perhaps, be expected. It is not safe, however, to prophesy on the basis of mere inspection what will happen in every work situation. Certainly it is not immediately obvious why the varied task should be *more efficient* than the simpler task in Figure 76. The attempt to clarify this will lead to the consideration in the following sections of other factors influencing the efficiency of set and shift.

THE RELATIVE COST OF UNIFORM AND VARIED WORK

In the absence of direct measures of cost of work in terms of heat generated or fuel consumed, progressive decrement in the course of continuous work is the most commonly used measure. The pitfalls to be noted in using such indirect measures have already been discussed in Chapter 6. With these in mind, such evidence as is available on the relative cost of uniform and varied work will be presented.

The use of the ergographic techniques long ago demonstrated the speedy "fatiguing" of single muscles, whereas superficially comparable tests of simple "mental" operations showed no such deterioration. Dodge (*140*) observed that if mental mechanisms comparable in simplicity to a muscle or groups of muscles could be exercised continuously they too would show a decrement. Even a simple series of associations, such as additions of single numbers, involves a variety of neural mechanisms and hence permits recovery of the mechanisms not working at the moment.

Experiments by Robinson and Bills (*525*) support these observations of Dodge and offer evidence that is not too remote from the problem with which this chapter is concerned. They compared the work decre-

ment over a period of twenty minutes of writing the following combinations of letters:

(1) ababababab, etc.
(2) abcabcabcabc, etc.
(3) abcdefabcdef, etc.

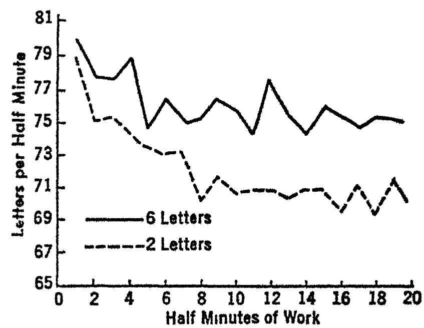
Series 1 represented the simple and series 3 the varied task, with series 2 in an intermediate position in respect to variety. The muscular or writing component was assumed to be equated in the various series. A number of experiments were performed with these combinations of material, and in each case the *less varied* material caused the *higher decrement*. Figure 77 shows the difference between the writing of two-letter and six-letter combinations, in a special experiment lasting only ten minutes in which the pencil was lifted after each two letters, thus:

ab ab ab *and* ab cd ef

The vertical scale is in terms of letters written per half minute of work, and the horizontal scale represents the successive half minutes from one to twenty. The two curves begin at about eighty letters per half minute, and from that point the two-letter curve falls more rapidly until at the end there is a difference of about five letters per half minute. Although the difference is not large in terms of percentage of the original score, it is so consistently present in the many experiments as to lead the investigators to believe that they were dealing with a very real difference.

FIGURE 77

DECREMENT FROM UNIFORM AND VARIED TASKS—WRITING LETTERS OF THE ALPHABET *



* From E S Robinson and A G Bills, "Two Factors in the Work Decrement,' *J Exp Psychol*, 1926, *9*, 426

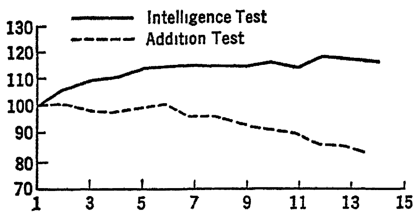
Data taken from an experiment of Poffenberger (*499*) confirm these results. He compared the decrement resulting from continuous work of two sorts. The first, which is the varied task, consisted in answering fourteen comparable forms of Part I of the Thorndike Intelligence Examination for High-School Graduates. Each form contained thirteen tests consisting of five to twenty different tasks and comprised one section of the experiment. The fourteenth section, which followed a rest period of ten minutes, will not be considered here. The uniform task was the addition to a specified two-place number first of 16, then of 17, 18, 19, then 16, and so on for thirty seconds, when a new

two-place number was given. This addition task was supposed to be continued for approximately five and a half hours, equaling the time required for the intelligence test. However, no one could continue so long as that, the actual working times for ten subjects ranging from one and one-fifth hours to four and three-fourths hours. One could, therefore, count the decrement as 100 per cent for every subject.

Figure 78 gives a picture of the results of the two kinds of work. The vertical scale is in terms of the percentage of the first score, which is taken as 100, and the horizontal scale indicates the fourteen sections of the experiment. To derive these subdivisions of the total working time for the addition test, the total duration for each subject was divided into fourteen parts so that the length of any section is peculiar to the individual subject. What the addition curve shows then is the decrement that occurred during the time that each subject worked.

FIGURE 78

DECREMENT FROM UNIFORM AND VARIED TASKS—INTELLIGENCE TESTS AND ADDITION *



* From A T Poffenberger, "The Effects of Continuous Mental Work," *Am J Psychol*, 1927, *39*, 283-296.

The intelligence-test curve rises about 20 per cent during the five and one-half hours, a degree of change that is just about the amount of improvement to be expected from repetitions of the test at intervals of one day. If this allowance for practice is deducted from the record, the five and one-half hours of work will appear to have shown no decrement at all, whereas the addition task, allowing for no practice in that function, showed a decrement of about 20 per cent. Thus, however the data in this experiment are viewed, the uniform work shows a greater decrement than the varied.

SATISFACTION FROM VARIED AND UNIFORM WORK

The evidence concerning the relationship between satisfaction from work and its uniform or varied character will have to be qualitative. As such it suggests individual differences in preference with a heavy predominance in favor of the varied work for the subjects investigated. The following statement taken from Jersild's (*322*, 36) study previously cited is pertinent:

If the shift test in the present case induces greater strain and tension than do the separate tests, and if this added strain has disagreeable effects, it should be possible for the subjects to observe it. To investigate this matter, the eighteen

subjects were asked to make a statement as to which test they preferred, the test calling for shift, or the test of the separate processes. Twelve of the eighteen preferred the shift test The reasons given were that it was not so monotonous, that the variety of stimuli gave added interest and incentive From this it can be seen that even though the shift may call into play a more elaborate response system, even though it may constitute a greater drain upon the nervous energy, yet the added feature of shift makes for more interest and enjoyment.

Hoppock (*290*) inquired of some eighty persons concerning what they liked most about a job. Among the five likes mentioned most frequently, and standing fourth, was variety in the work. The five were:

1. Associates
2. The work itself
3. The boss
4. Variety
5. Freedom in work

Watson (*680*) describes an inquiry from 157 young men as to why jobs proved interesting, and found that variety of work again stood fourth in terms of percentage of times mentioned, as is shown in Table 49 in the first column of figures to the right.

TABLE 49

VARIETY AS A FACTOR IN JOB SATISFACTION *

	157 Men	*100 Men and Women*	
	Per cent	Percentage of men	Percentage of women
1. In line with vocational aspiration	29	15	13
2. Congenial contacts with people	24	21	38
3. Responsibility, initiative, prestige	19	27	23
4. Variety	12	15	12
5. Opportunity for promotion	8	16	2
6. Salary	4	13	6
7. Short work hours	4	3	6

* Adapted from G B Watson, in G W Hartmann and T Newcomb (editors), *Industrial Conflict* (New York, The Cordon Co, 1940), p. 120.

It is interesting, indeed, that variety should be mentioned three times as frequently as either wages or hours. Another sample of one hundred cases, men and women, is reported by Watson with surprisingly similar results as appears in Table 49, the percentages being given separately for men and women in the second and third columns of figures. Here, again, variety of work stands fourth in order of importance for both men and women. In still another sample of one hundred cases, Watson reports that only seven persons preferred uniformity to variety in work.

FIELD STUDIES OF SPECIALIZATION

Among the field studies of varied and uniform work, those of Wyatt and Fraser (*725*) yield quantitative data on production comparable to the laboratory findings reported in this chapter. They investigated six industrial occupations, in which the variety consisted either in shifting from one kind of work to another, a set-up resembling in that respect the laboratory experiment of Culler, or of doing a varied task analogous to that of Jersild. Two of the occupations, together with the results of their uniform and varied program, were as follows:

1. In soap wrapping the varied work consisted in going to a supply room for 144 cakes of soap and wrappers, wrapping the cakes, packing them in boxes of three, wrapping and sealing these boxes in sets of four, and carrying the finished package to a conveyor The simple job consisted merely in wrapping and packing in boxes. The uniform work was 3.2 per cent more efficient on the average in the case of the six subjects included in the experiment, the range among the individuals being from 0.5 to 6.2 per cent.

2. In handkerchief folding eight persons were studied during a period of three weeks. The varied work consisted in hourly alternation between two styles of folding, the one known as oblong and the other as French. The uniform task called for continuous folding of one style only. In this case the difference is 1 per cent in favor of the varied operation, an advantage too small to be considered reliable. More interesting than the size of this difference are the scores for the individuals, some of whom do and some of whom do not profit from the introduction of variety. When a plus sign means favorable to variety, the percentages are − 1.6, − 0.7, + 0.4, + 0.4, + 1.2 + 1.8, + 2.9, and + 3.9. In the other four types of operation that were investigated the advantage was in favor of the varied program, although individual differences were pronounced in these cases too.

Analysis of the data led the authors to a series of conclusions that support those reached by Culler and by Jersild. First, the relative efficiency of variety and uniformity depends upon the nature of the work. Second, it depends upon the nature of the alternating or varying components of the program. Third, it depends upon the frequency of alternation. And fourth, it depends upon the regularity of the schedule according to which the shifts are made. There should be added to these the findings of Jersild that the facility for dealing with a varied task depends upon the degree of practice in it. Both Jersild and Culler suggested that whatever loss was incurred from shifting might be entirely overcome by long-continued practice.

INDIVIDUAL DIFFERENCES IN REACTION TO UNIFORMITY

One additional factor should be noted in the data of these studies, although it is not particularly emphasized by the investigators, namely, the differences among individuals in susceptibility to uniformity or variety of work. There is some evidence that one of the determinants of such individual differences is intelligence level. A positive correlation between intelligence and reaction to varied work could be expected from the definition of intelligence itself, in which adaptability to changes in the environment is one of the most frequently cited components. The data provided by Jersild give some quantitative evidence concerning this relationship. Ten different groups of subjects, measured in ten different tests of set and shift and also subjected to one or another form of intelligence test, furnish an interesting series of correlation coefficients. Of the several measures of capacity to shift, or of adaptability, employed by Jersild, the most plausible one seems to be the percentage of shift loss, that being the percentage of increase in time when shift is introduced. When the reciprocal of the percentage of shift loss * was correlated with intelligence by the Rank Difference Method, every coefficient except one was positive, and this case was exceptional in other respects also. The eighteen coefficients range from —.06 to +.47. Although many of these coefficients when taken individually are unreliable by statistical test, the fact that they are so uniformly positive lends weight to the conclusion that there is a real, positive relationship.

The following tentative application of these results might be made to the practical problem of adjustment to work: If highly specialized and uniform operations are to be a necessary part of the world's work, they can be performed with the greatest efficiency (as defined) by persons of the lower intelligence levels. A matter so important as this obviously demands more intensive research and will be dealt with more adequately in Chapter 24.

* To provide an order according to degree of freedom from shift loss.

21

Adjustment to Uniformity and Variety of Work-Standardization

Two kinds of uniformity and variety of work have been examined in the preceding chapter. These are, first, the performance of one task exclusively as contrasted with the alternation among two or more tasks, and, second, the performance of a relatively complex task as contrasted with that of a relatively simple task. There is a third sense in which the terms uniformity and variety may be used, namely to designate the changing or unchanging character of the work from one unit or cycle of it to another. In business and industrial programs this type of uniformity is comprehended within the concept of standardization and constitutes the most spectacular aspect of current efficiency systems.

Many factors in the evolution of the production process have led to a seeming necessity for increasing uniformity in the work done by man in this complex of events. There is, first and possibly most important, the introduction of automatic machinery, which by its very nature sets the pace at which operations are to be performed and repeats its cycles with unvarying precision. The worker must adapt his reactions to its speed and its rhythm. To be sure, the pace of the machine may be set, in the first instance, to match the pace of workers or of some worker, but once it is set the worker must follow. Second, and paralleling the first, there is a general standardizing of everything that enters into the production process, machines, materials, tools, and work places, with the consequent decrease in the acceptable variation of response allowed by this increasing uniformity. Third, the urge for increasingly efficient modes of operation together with the discovery that the human component is a very large item in the cost of production leads to the search for "the best way" to do things. When this "best way" has been found it becomes the uniform pattern or standard to be rigidly followed until research discloses a better "best way."

STANDARDIZATION IN EVERYDAY LIFE

Standardization is no more foreign to the everyday life of the layman than is specialization. Every one standardizes certain aspects of his program of living, establishes a routine, or falls into a rut. He adopts a standardized manner of dress, follows a schedule of three meals a day, reads the same daily newspaper, expresses his views on matters of current interest in a stereotyped fashion; even his profanity takes on a degree of uniformity sufficient to identify him among his associates. All of these reactions can and do occur without thinking and without choice among alternatives. It has been the privilege of the writer to know well one person who had apparently standardized no single aspect of his living so that nearly every action in the course of a day called for deliberation and decision. What suit of clothes to be worn, what to eat for breakfast, shall this letter be mailed, shall one go to work by trolley, subway, or taxi. One needs to know only one such person to realize the efficiency of a relatively unvarying routine for much of what he does. William James (*314,* Vol. I, *122*) presents the case dramatically in the following passage:

> The more of the details of our daily life we can hand over to the effortless custody of automatism, the more our higher powers of mind will be set free for their own proper work There is no more miserable human being than one in whom nothing is habitual but indecision and for whom the lighting of every cigar, the drinking of every cup, the time of rising and going to bed every day, and the beginning of every bit of work, are the subjects of express volitional deliberation. Full half the time of such a man goes to the deciding, or regretting, of matters which ought to be so ingrained in him as practically not to exist for his consciousness at all. If there be such daily duties not yet ingrained in any one of my readers, let him begin this very hour to set the matter right.

SCOPE OF STANDARDIZATION IN INDUSTRY AND BUSINESS

One cannot accept the admonition of William James as justification for the standardization and routinizing of every thing and every act without careful examination of their effect upon real efficiency, involving, as it should, not only output but cost and satisfaction as well. A brief inspection of the standardizing techniques and of the standardized processes will provide the basis for a search into the psychological principles involved (*26*) (*434*) (*538a*). Gilbreth (*208*) in his Motion Study, presents a list of forty-two variables taken from a larger one containing 119 items that call for standardization. They are divided into three groups, namely, variables of the worker, variables of the surroundings, equipment, and tools, and variables of the motion. The

first and third of these are of particular interest to the psychologist. Sample items from the three lists follow.

1. *Variables of the Worker.*—Anatomical characteristics; strength and endurance; temperament; race, religion; earning power, experience; habits of thought and action; attitude toward health; and training and skill.
2. *Variables of the Surroundings, Equipment, and Tools*—Appliances and tools, such as chairs, tables, wrenches and files; clothing of the worker, heating, ventilation, and lighting, quality of materials, size and weight of unit of material to be handled; colors used for various purposes; shop rules and regulations; rewards and punishments, and entertainment.
3. *Variables of the Motion*—Inertia, momentum, and acceleration; speed; direction; length; path, foot-pounds of work accomplished, cost; and effectiveness.

STANDARDIZATION OF THE WORKER

The important thing to note about these lists is that they are lists of *variables* and that they are to be *standardized.* The concepts of variation and standardization are in a sense incompatible, and there is some contradiction between them as they are used here. However, in another sense they are not antagonistic. Thus, in the group of variables of the worker there is recognition that individuals do differ among themselves in such characteristics as size, strength, skill, and temperament. Obviously these variables cannot be ironed out by any standardizing process. What amounts to the same thing can be accomplished by *selecting* for a given task only those persons who have the qualifications which the job requires. The specifications for the job are standardized but the workers are not. If it is found that better results are obtained from a gang of workmen when they are all of the same nationality, or of the same height and weight, or of the same degree of skill, only those who fit the specifications need be selected for the purpose. Such standardization is a psychologically sound technique of vocational selection.

STANDARDIZATION OF SURROUNDINGS, EQUIPMENT, AND TOOLS

The second group of variables calls for standardization of surroundings, equipment, and tools. It is possible to establish generally optimal conditions in such matters as illumination, temperature, and area of working space without doing serious violence to the characteristics and preferences of individuals. So far as equipment is concerned, much can be done to meet individual needs by providing adjustable tables, chairs, and footrests, or by fitting them to the individual, arranging

work materials so they can be easily reached, and providing for a shift between standing and sitting as the worker desires. An illustration of such adaptations is given in Figure 90, facing page 416.

The standardizing of tools without violating individuality presents a problem of greater difficulty. It would not be feasible to cater to the individual taste of each worker in furnishing tools and machines. The standardization of shovels by Frederick Taylor, one of the earliest and most frequently quoted efficiency studies, will illustrate the essential characteristics of the process of standardizing tools. As Barnes (*26*, 11) describes it:

> With little investigation Taylor found that shovelers were lifting loads of three and a half pounds when handling rice coal and up to thirty-eight pounds to the shovel when moving ore. He immediately set about to determine what shovel load permitted a first-class shoveler to move the most material in a day. Taylor took two good shovelers and set them to work in different parts of the yard and set two time study men with stop watches to study the work of these men At first large shovels were used so that heavy loads were taken. Then the end of the shovel was cut off to permit a smaller shovel load and again the tonnage handled was noted The procedure was continued—from very heavy shovel loads to very light ones. The results of this study showed that, with a load of twenty-one and a half pounds on the shovel, a man could handle the maximum tonnage of material in a day. Thus a small spade-shovel that would just hold twenty-one and a half pounds was provided for the worker when he handled ore and a large scoop was provided for light material, such as ashes.

The worker was required always to *fill his shovel,* with the result that he would be handling the standardized unit of load. This procedure succeeded one in which the worker furnished his own shovel and loaded it as he saw fit. The quotation from Barnes indicates that the standardization was based upon what a *first-class shoveler* could do. Presumably, only persons capable of meeting the standards could be employed for the work. The increase in output resulting from this innovation has been reported to be in the neighborhood of 300 to 400 per cent, and the financial cost of handling a ton of material was reduced by about 50 per cent.

The most efficient use of the screwdriver has been the goal of intensive study. From the various lines of research there have evolved standards for shape and size of handles (*532a*) for various tasks, for the shape and length of blades for the many types of screws, and for prepositioning and positioning arrangements according to the work to be performed (*26*, 224-236). A tool so frequently and so widely used warrants such thorough search for the most effective and the least tiring designs.

The standardization of the variables comprising the first two groups raises many questions of psychological import that have not been

given the consideration which they deserve. These questions have tended to be overlooked because they concern mainly the satisfaction of the worker, a seriously neglected phase of efficiency. For instance, who knows what standardized clothing will do to the worker, the functional uniform which is a badge of the kind of service rendered? The uniform of the soldier, of the nurse, of the railroad engineer, and of the elevator operator carries dignity, but does that of the white-wing (street cleaner) or the clerk in the department store do likewise? Who knows what are the best colors for office and shop walls, or the best quality for interior illumination? If music is to be used to increase efficiency, as it sometimes is, who knows the most appropriate sort to use? These are merely sample questions, for which answers could be found if the answers were considered sufficiently important. The alert observer of the world of work can discover many others.

STANDARDIZATION OF MOTIONS

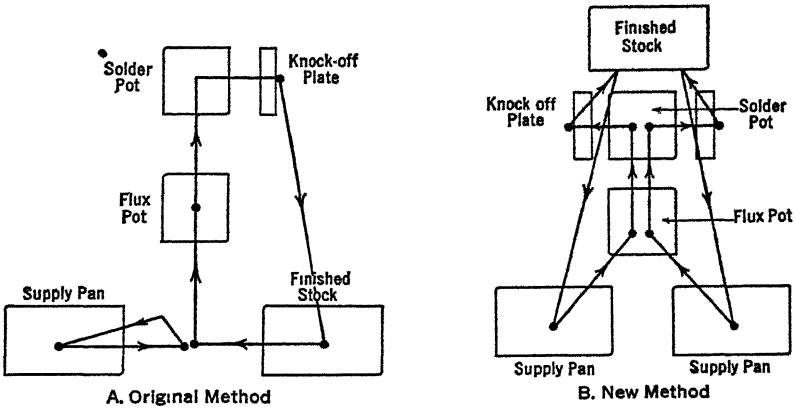
The standardization of the worker's movements carries the greatest psychological implications. It deals with what the worker shall do and how he shall do it, that is, it purposes to standardize his behavior. It is here that human individuality and standardized patterns are most likely to come into conflict. Movement habits of long standing, preferred rhythms of movement for the body or its parts, a tendency to be bored by routine, a desire to go one's own way or to be independent, and idiosyncrasies of personality in great variety are only a few of the probable sources of problems that may follow in the wake of standardized programs.

A very simple case, described by Mogensen (*434*, 58), will illustrate what can be accomplished in the way of increased production by a modification of the pattern of movement. The task consisted in coating with solder the terminal blocks to which wires were to be fastened in a later assembly. The blocks were too large for two to be held in one hand. The original movement pattern is shown on the left of Figure 79, where supply pan and finished-stock box stand to the immediate left and right of the operator. Farther away in a central position stands the flux pot, containing a composition into which the block is dipped before soldering. Beyond that is the pot of melted solder, and to the right of that there is a metal plate against which the block is tapped to shake off excess solder. The diagram shows that the left hand picks a block from the supply pan, passes it to the right hand then returns for another. The right hand takes the block to the flux pot, to the solder pot, strikes it upon the knock-off plate, and finally drops it into the finished stock box.

The right half of Figure 79 shows the revised layout and the changed movements. There are two supply pans, one on either side of the operator, the box for finished stock stands just beyond the solder pot, and there is a knock-off plate on either side of the solder pot. The two arms make simultaneous, symmetrical movements in opposite directions, picking up a block, moving it to flux pot, to solder pot, to knock-off plate, finally to box for finished stock, and returning for another block. In the original pattern the time per movement cycle and hence the time per unit of product was .12 minute In the revised pattern, the time per

FIGURE 79

IMPROVING AND STANDARDIZING A MOVEMENT PATTERN *



* Adapted from A H Mogensen, *Common Sense Applied to Motion and Time Study* (New York, McGraw-Hill Book Co, 1932), p 58.

movement cycle was .13 minute, but since two units of product were done, the time per unit was .065 minute. This is an increase in production of 84.6 per cent. Mogensen reports a reduction in financial cost per unit of 46.8 per cent. Still further slight improvement could be made by introducing a finished stock box on either side between the knock-off plate and the supply pan, so that the finished block could be dropped on the return to the supply pan The principal change in the new set-up is the introduction of bilaterally symmetrical movements which permit equivalent rhythmical reactions of the two sides of the body.

FINDING THE ONE BEST WAY

Not all movement studies are so simple as the one just described. Motion pictures of already efficient operators taken at the rate of 1,000 per minute, stereoscopic photography and projection apparatus, and accurate time measuring and recording instruments make it pos-

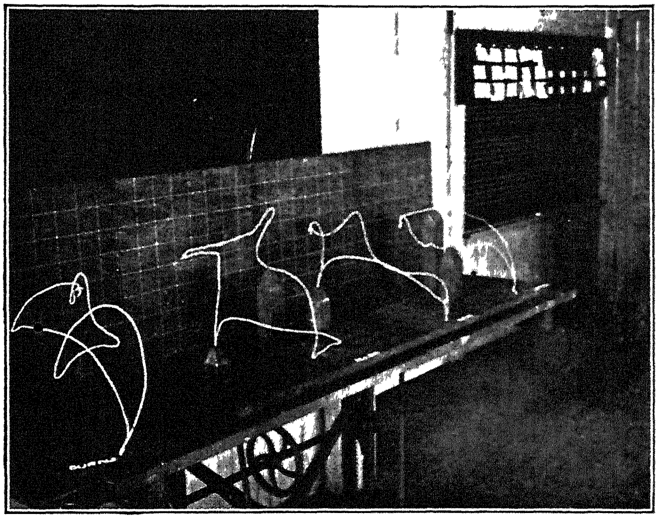
sible to analyze even the simplest movement into as many as fifteen components. Wire models of the path of a movement are frequently constructed, which show clearly the unnecessary part motions and inaccuracies at various stages of the motion. These are eliminated so that the reconstructed motion comprises nothing but what is essential for accomplishing the desired result and is actually *the one* best way to be prescribed for all workers. Figure 80 (*210,* 90) reproduces four such wire models showing, from left to right, the evolution toward the "best" motion of the left hand in working a drill press. The extreme simplicity and smoothness of the last curve compared with the first, together with the elimination of unnecessary starting and stopping reactions, represent a large percentage of the time saved.

The type of analysis of movement that is made from motion pictures is illustrated in Figure 82, from the work of Douglass and Dealey (*144*). This is a simplified motion-cycle chart that compares the right arm movements made by two boys in reaching for a piece of wood, transferring it to a vise, tightening the vise, picking up a plane, and planing. Both the position of the arm and the time are read directly from the motion picture, so that it is a simple matter to calculate the time required to go from one position to another, the time lost before beginning a motion, and so forth. It is these times that are transferred to the motion-cycle chart. The unit of time that appears on the scale to the left of the chart is one four-hundredth of a minute. On the left and right of the chart the reactions are indicated by short expressions and abbreviations. The records are to be read downward, the height of the rectangle showing the time spent in the particular act designated. Boy *B* is much more efficient than boy *A*. Both worked the same length of time. *B* spent about forty units of time in the motions preliminary to planing, while *A* spent about a hundred units. Furthermore, *A* took an appreciable interval to get his plane into position at the beginning of each stroke, whereas *B* had a rhythmical motion which automatically brought the plane into the correct starting position. These two records show clearly how differently such a simple task can be performed and what opportunities there are for saving a large percentage of time in performing it.

The minuteness of the analysis may be understood more clearly from an inspection of Figures 81 and 83 taken from Barnes (*26,* 101, 166). The former shows an old and a new way of folding sheets of paper, the path and direction of the movement being shown by the broken lines and the arrows. Figure 83 shows the analysis of the new movement into its components. This is a simplified chart, even though it shows separately the right and left upper and lower arm, wrist, thumb, the four fingers, and palm of the hand. A complete chart would show also

FIGURE 80

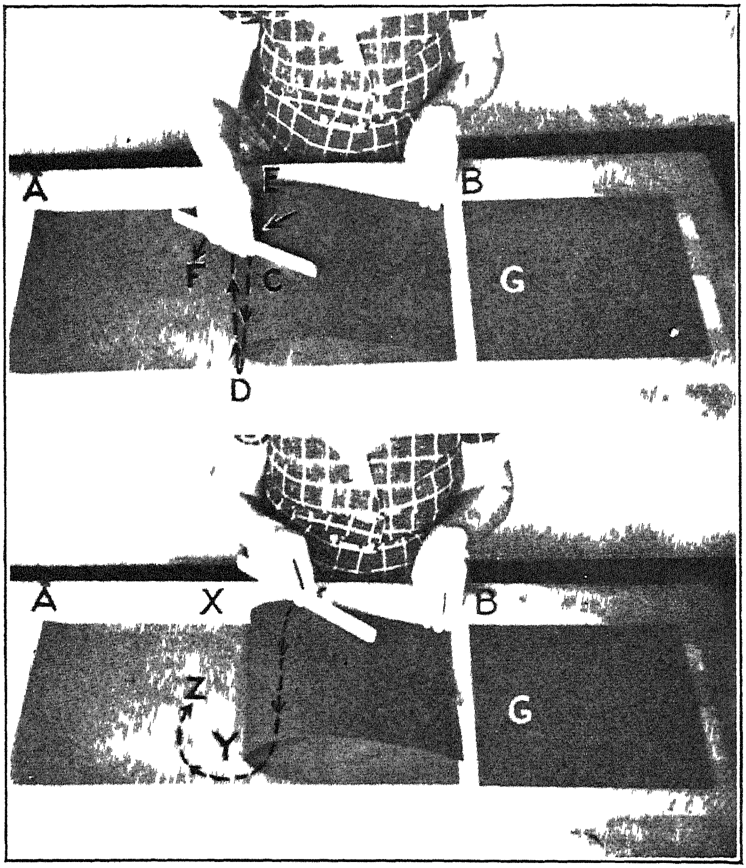
STANDARDIZATION OF A SIMPLE MOVEMENT *



* From F B Gilbreth and L M Gilbreth, *Applied Motion Study* (New York, The Macmillan Co, 1919), p 90

FIGURE 81

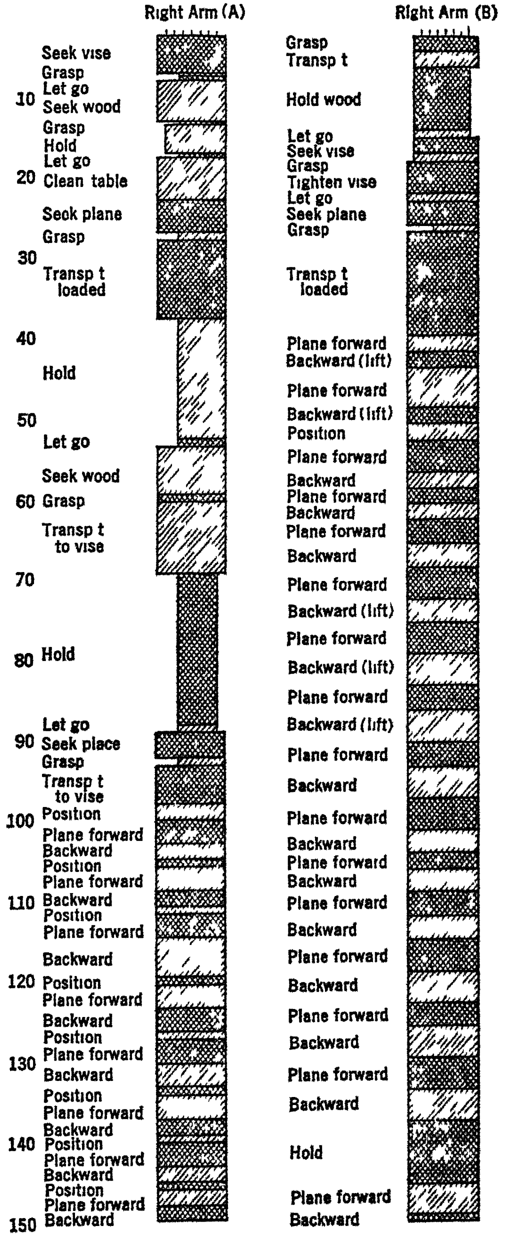
THE BEST WAY TO FOLD A SHEET OF PAPER *



* From R M Barnes, *Motion and Time Study* (New York, John Wiley and Sons, 1940), p 166

FIGURE 32

ANALYSIS OF THE MOTION OF PLANING



* From A A Douglass and W L Dealey, 'Micromotion Studies Applied to Education, *Ped Sem*, 1916 23 255

the movements of the legs, head, trunk, and shoulders. The time scale on the left is in units of one two-thousandth of a minute, known as a "wink" in the symbolism of motion study. The motion made by each body unit and the time consumed in making it can be shown on such a chart, although these details are not all recorded on this one. The total time required for folding in this improved fashion is about .005 minute as contrasted with .009 minute by the earlier method. A saving in time of this magnitude in an operation repeated many thousands of times in a day represents a great increase in efficiency. A study of the course of the motion in Figure 81 will suggest that the improvement comes largely from the substitution of a curve with a gradual change in direction for a pattern of movement containing two sharp reversals of direction.

Sometimes the changes made are not in the path of movement itself but rather in the arrangement of the worker's body, his material, tools, and equipment. Thus, in Gilbreth's (*210*, 42) classical study of bricklaying operations, the changes made were mainly in the disposition of materials and in the routing of work. These changes brought up the average number of bricks laid per hour from the traditional standard of 120 to 350 per man, and reduced the number of movements in laying a brick from eighteen to five. Equally striking improvements have been obtained by modification of the surroundings of the worker. The effects of improved lighting arrangements, the installation of proper ventilating equipment, and the removal of distractions were discussed in Chapters 7, 8, and 9. These matters are beginning to receive serious attention in business and industry. Other environmental changes such as improved washroom, and lunching and recreation facilities will, doubtless, have beneficial, though less tangible, effects upon production.

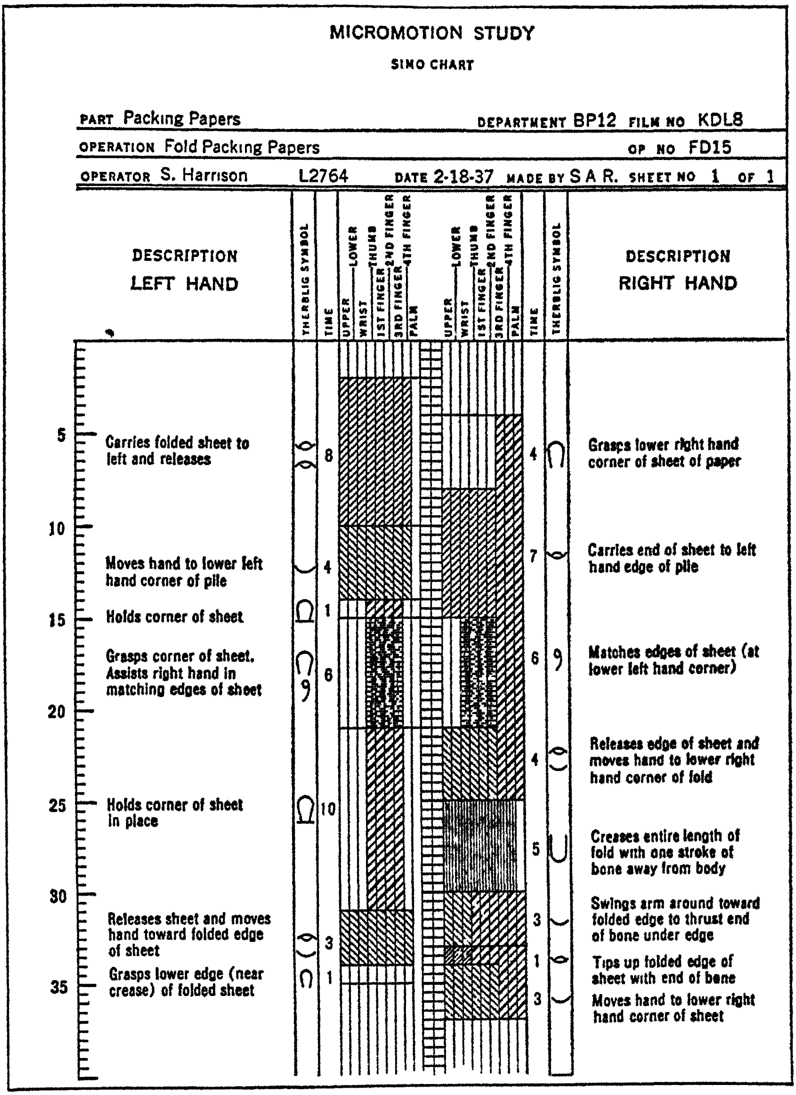
THE COST OF STANDARDIZED OPERATIONS

Every study of the effect of introducing standardized methods upon production yields also a measure of its effect upon cost. But the cost changes are in terms of the reduced wage charge, reduced power charge, and reduced overhead. The only representation of the human cost that appears directly in the computation is in terms of the worker's time and what that amounts to in dollars.

The most commonly used measure of human cost is an indirect one, expressed in terms of the change in output of work over a period of time, a fraction of a day, a day, a week, a month, or a year. If the period of time over which the study is made is sufficiently long—months might be necessary—it is probable that changed output would reflect the changed condition of the worker. However, production is

FIGURE 83

Analysis of the Paper-Folding Motion Cycle*



* From R M Barnes, *Motion and Time Study* (New York, John Wiley and Sons, 1940), p. 101.

at best a questionable measure of cost, as suggested in earlier chapters. This will be dealt with more fully in Chapter 23.

The curves in Figure 84 on page 397 give some notion of the decrement following standardized repetitive operations continued for only

thirty minutes. Each cycle of the work lasted two seconds, so that in the half hour there were 900 exact repetitions of the cycle. An appreciable decrement is noticeable in terms of the number of cycles lost per minute of work. This case is especially interesting since it represents, in the nature of the work and in the short duration of the cycle, many current industrial operations.

One or two observations will be made to put the reader on guard against accepting too uncritically the increases in output as signs of increased efficiency. Any improved method of operation that increases the number of cycles of a simple movement pattern per unit of time raises the frequency of use of the central control mechanism as well as of the muscular mechanism. Thus, in the paper-folding study reported on page 388 the time per cycle was reduced from .009 minute to .005 minute. The improved technique requires repetition at the rate of about 180 times per minute, or about 10,000 per hour. No matter how the increased speed may be brought about, the fact of this high frequency repetition remains, producing a working situation that resembles very closely the laboratory study of Robinson and Bills described on page 376. These investigators demonstrated a decrement, under such circumstances, that was readily measurable over a period of only twenty minutes. Robinson (*521*) has formulated seven principles of the work decrement of which the first two are: (1) the work decrement of a given *S-R* (stimulation-response) connection is relative to the recency of the previous functioning of that connection, and (2) the work decrement of a given *S-R* connection is relative to the frequency of the previous functioning of that connection. Both these principles apply directly to the paper-folding operation and would lead to the expectation of a heavy decrement from the high frequency of repetition of that unvarying movement cycle, unless compensating or correcting influences such as incentives are introduced to alter the decrement.

Dodge (*140*) called attention to another potent influence at work in high frequency repetition when he referred to those more slowly changing inner determinants of action that are called motives, controls, and the like. It seemed probable to him that these inner factors, in so far as they are the only continuously acting factors in mental work, are more apt to be the locus of absolute fatigue than the several discrete association tendencies which are involved only occasionally in the mental task. So long as the repeated movement is not absolutely automatic—and it never is that—just so long will the exercise of central control of some sort be necessary. This control is variously named as attention, interest, motivation, or drive and its decrement is identified as distraction, monotony, boredom, or weariness. It is to be

expected, therefore, that the consequences of such decrement would be reflected in the human cost of repetitive work. The chapters on Distraction and Monotony (7 and 10) have discussed these problems in detail.

SATISFACTION IN STANDARDIZED WORK

Direct measures of the satisfyingness of any work condition are limited to the observations of the workers themselves, and the number of such observations reported in the literature is not great. Among the reasons for a dearth of such important information is the highly subjective and hence unstable nature of such reports, and the hazard generally felt by employers in raising the question of satisfaction and dissatisfaction in the mind of the worker. Watson (*680*) records some data that are both interesting and pertinent. They were obtained from a group of 225 unemployed young men who were asked which of the jobs they had held proved most interesting and why. Among the many reasons given, variety stood fourth and constituted 12 per cent of the usable replies. Another sample of one hundred cases of men and women from a population similar to that just mentioned placed variety of work fourth in importance, with 15 per cent of the replies from men and 12 per cent from women. In another test that called for checking the three most important factors that affected the work, "freedom in working out one's own method of work" stood out as fourth in importance with a frequency of 32 per cent. It was, however, rated least important for 28 per cent of the cases.

Hoppock in the study cited on page 379 reported "freedom in work" as standing fifth in a list of factors affecting satisfaction with one's job. And the inquiry by Watson referred to on page 379, placed "opportunity for initiative" third in a series of factors along with responsibility and prestige. Houser (*294*) surveyed the attitudes of 100,000 people, and among the factors that mattered most to them "being encouraged to offer suggestions and to try out better methods" stood second in importance. Among the 159 cases of the Watson inquiry (*680*) "only fourteen thought they could better meet the competition of others in 'routine or standardized work,' rather than in 'meeting new and different conditions.' "

All of these instances of direct observation give evidence of a preference for freedom and initiative as contrasted with standardization of performance. To be sure, there were indications of individual differences, some persons not attaching great importance to the uniformity of the work, and a few seeming to prefer standardized operations.

PSYCHOLOGICAL ASPECTS OF ROUTINE WORK

Several psychological mechanisms have already been referred to in the description and interpretation of the effects of routine. These scattered statements will be gathered together and somewhat amplified. Some of them will clearly support the expectation of an increased output from routinizing an operation, whereas others will seem to negative this advantage to a certain degree by increasing cost or decreasing satisfaction. The suspicion will have arisen in the mind of the reader that the consequences of standardization are not simple and readily predictable but are just as complex as those following specialization were found to be.

The general observation may be repeated that standardization and individuality are in a sense antagonistic. To set a fixed pattern according to which an operation is to be performed leaves no room for the operator to express his individuality, to vary his reactions now this way and now that way as his fancy dictates or as his tired muscles demand. The difficulty cannot be avoided entirely by careful selection of workers, although means can be found for detecting those who will be least adversely affected by routine.

IMPLICATIONS OF HABITS

The facts of habit formation would seem to justify a high degree of automaticity in repeated operations both from the point of view of output and of cost. William James (*314*, Vol. I, 104-127), in his famous chapter on habit, listed a number of practical applications and implications of the facts of habit. No research in the intervening years has served to refute these keen observations of James, although theories concerning habit have undergone many changes. "Habit simplifies the movements required to achieve a given result, makes them more accurate, and diminishes fatigue," and it "diminishes the conscious attention with which our acts are performed." The implications of these two characteristics of habit are:

(1) Make automatic and habitual, as early as possible, as many useful actions as we can
(2) Launch into the new habit pattern "with as strong and decided initiative as possible."
(3) Never suffer an exception to occur until the new habit is securely rooted
(4) Make the most of "every emotional prompting you may experience in the direction of the habits you aspire to gain."

One can find in these implications a justification for planning ahead just how the operation is to be performed, and requiring that it be done

in that "proper" way from the very beginning. He will find support also for the use of incentives of various kinds in order to keep the effort at a high pitch.

ADVANTAGE FROM SYMMETRICAL AND SYNCHRONOUS MOVEMENTS

The greater efficiency of bilaterally symmetrical and synchronous movements than of simultaneous but unsymmetrical movements or of alternating unilateral movements has long been recognized (*28a*) (*28b*). The difficulty of "*rubbing* the head and *patting* the stomach at the same time" illustrates the first of these, and the greater number of units of work that can be done with two hands than with one shown in the operation on page 387 illustrates the second. The reason generally given for the ease and efficiency of bilaterally symmetrical movements is in the control of motor responses of both sides of the body by the one dominant cerebral hemisphere, the left one in right-handed persons. In fact, it has long ago been demonstrated by experiments (*711*, 181-189) that skilled reactions learned by one side of the body are thereby acquired mirror-wise by the corresponding member of the other side of the body. Writing by the left hand in a right-handed person resembles that of the right hand even though the left hand has never been trained to write. Whatever the controlling mechanism may be, one seems to be able to attend to such double bilateral movements as though they were single movements, and thereby with a given central innervation turn out two units of product instead of one.

ECONOMY OF RHYTHMICAL MOVEMENTS

Rhythmic movements are generally supposed to be more efficient than those in which no rhythm is experienced. For instance, Ryan and Florence (*536*), physiologists of the Public Health Service, say that rhythm relieves attention and its consequent fatigue; renders more uniform the metabolism and recovery involved in the operation by evenly distributing the work; masks fatigue effect; and influences the accident hazard. Burtt (*73*, 121-127) attributes the advantage of rhythm to the fact that one impulse can control a number of repetitions of the act. Added importance attaches to rhythm from the fact that there are said to be preferred rhythms (*176*) on the part of races, nationalities, age groups, occupational groups, and individuals with which movement cycles should be reconciled.

Inspection of the literature on this subject, particularly that reviewed by Foley (*176*), shows that the term rhythm is used in several different

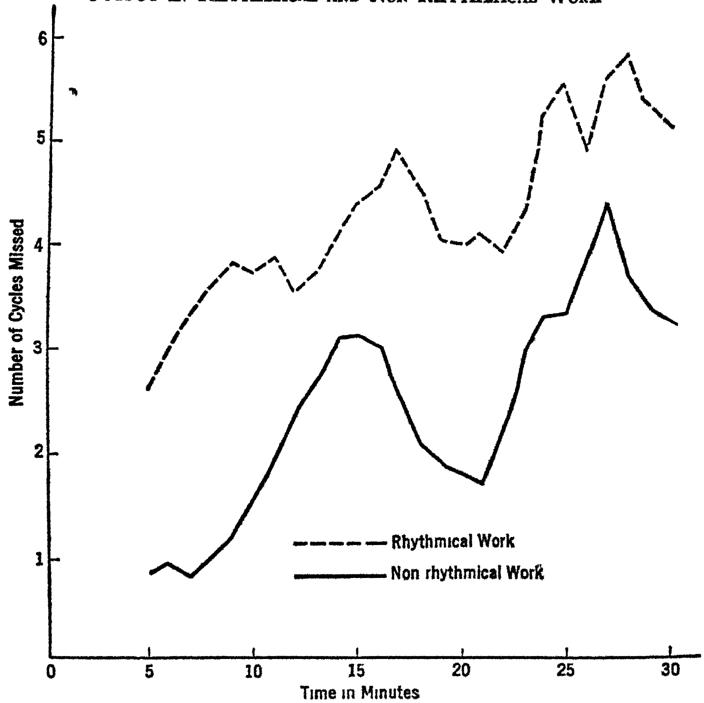
meanings. First, it means tempo or the rate at which stimuli or movements are repeated, so that a rhythm may be quick or slow. Second, it means regularity of sequence, as when Burtt says that "we breathe in rhythm, our hearts beat in rhythm, we walk rhythmically, and even chew our food in this fashion." Third, it means also the grouping of units of action in larger wholes so that the *groups* are attended to and initiated as *units*. This grouping may be objectively produced either by a temporal arrangement of repetitive reactions or by accenting the beginning or termination of a group in some fashion. The former method of grouping is illustrated in a study of Barnes and Mundel (*28*) in which cycles of three simple reactions were repeated with an opportunity for the worker to introduce a slightly longer interval between cycles than between units of a cycle. The second is familiar in the rhythm of poetry. Finally, rhythm may mean the psychological phenomenon of experiencing groupings of stimuli or motor responses where the series are objectively uniform, as in the patterns of sound that one can hear in the ticking of a clock or the beating of his own heart.

Most of the field studies of rhythm have been concerned with either the first or the second of these meanings. Nothing further need be said about them here, since frequency and uniformity have been discussed earlier in the chapter. If rhythm in the sense of the third and fourth definitions could be impressed upon work cycles, so that attention and control could be limited to groups or cycles rather than to individual units, efficiency might well be expected to increase. The interesting study by Barnes and Mundel (*28*), mentioned above, did not, however, show such an advantage for what they designated as rhythmic work. They set up a kind of "three-hole test" in which the tempo was predetermined and the accuracy of the stages in the cycle of movement was guaranteed by the fact that each hole became available for a "contact" only during the appropriate moment. (Each hole was open for only .4 second.) Two temporal patterns were set up, comprising a series of 900 cycles, each involving one circuit of the three holes in a period of two seconds. The required distribution of times within the single cycle was such that in the one pattern there seemed to be a rhythm and in the other there appeared to be regularity without rhythm. The curves for these two work conditions are shown in Figure 84, adapted from Barnes and Mundel. Each curve is a five-minute moving average for all subjects as indicated on the horizontal scale. The vertical scale represents the number of cycles missed per minute. It appears that the rhythmical series is less efficient than the non-rhythmical, suffering a disadvantage that remains fairly uniform in amount throughout the whole thirty-minute period However, a careful

examination of the work situation and of the comments of the workers shows that whereas the task labeled rhythmical did arouse a feeling of rhythm in the sense that there was a break between the cycles, thus making each cycle stand out as a unit, there was no lessening of attention and control for the components of such rhythmical units. For instance, one worker said, "It makes groups of three holes, but breaks the continuity of action," while another said "'Good grouping and breaking of work into cycles but requires slightly more concentration,"

FIGURE 84

OUTPUT IN RHYTHMICAL AND NON-RHYTHMICAL WORK *



* From R M Barnes and M E Mundel, 'Studies of Hand Motions and Rhythm Appearing in Factory Work," *Univ Ia Stud Eng*, 1938, Bull No 12.

and another said "Good grouping on this but it requires closer attention while it appears not to." Thus the particular conditions of the experiment deprived the worker of the only advantage that a real rhythmical series could have over a non-rhythmical one. It is very probable that subjective grouping could occur more readily in the regular series which was called non-rhythmical with the expected saving in the effort of control. The ingenious technique of Barnes and Mundel could well be used for further exploration of this problem

22

The Rôle of Incentives in Work

The need for the application of incentives has been almost universally recognized in a culture where nearly every one is working "for" some one else and where the fruits of one's labor do not reside directly in the accomplishment but accrue in some more indirect form such as wages. The need has increased and expanded with the adoption of work methods and work schedules which no longer reflect the "natural inclinations" of the worker but, on the contrary, demand conformity with a predetermined and standardized program. The increase in the use of incentives has been accompanied by a more intelligent use of them. The old and traditional incentives of fear, punishment, and compulsion have been giving way in well-organized institutions to the arousal of initiative, coöperation, and pride in achievement. Industrial democracy in its best sense means that the worker takes a responsible part in his own management, and that incentives such as ambition, pride, fairness, love of the game, loyalty, and social recognition supplement or entirely replace wages, punishment, and fear of discharge.

The use of incentives as a spur to increased production rests upon a thoroughly sound psychological foundation. Where incentives fail, the difficulty may be traced to a failure to understand their nature, to their misuse, or to a false conception of what can be expected from them. Instances of all these shortcomings will be found in the following pages.

THE MEANING OF INCENTIVE

The dictionary definition of the word *incentive* gives an interesting clue to its practical meaning. It means that which incites, spurs, stimulates, or encourages to action, figuratively, that which "sets one on fire." The practical implication would seem to be that a given object or situation can be stimulating and that therefore such object or situation should constitute an incentive. This is not necessarily the case. A simple instance from the animal laboratory will demonstrate a prevailing fallacy in the use of incentives. Food is perhaps the commonest

incentive in research with laboratory animals. In learning experiments food is the reward that the animal tries to attain by threading its way through a maze to the food box. But food constitutes a spur to action only when the animal is hungry. If a well-fed animal is put into a maze it will probably lie down in a corner instead of finding its way to the food box. Food, therefore, constitutes an incentive only to a hungry animal which is receptive to food. Likewise, an increase in wages will be an incentive only to a workman who wants money, and a promised holiday will be an incentive only to one who desires a holiday. It would be technically more accurate to say that hunger is the incentive rather than the food, that the need felt for something is the incentive rather than the money that will buy it. However, it is not necessary to go so far as that, but it is necessary to recognize that some control must be exercised over both the *objective* situation and the *need* if there is to be a genuine incentive. A worker may go on strike in the face of a prospective increase in wages if what he needs or desires is not more money but a recognition of his union.

The stimulus-response diagram *S-R* would characterize the reaction to an incentive if its potency resided only in the objective situation. Given the stimulus, *S*, one could predict the response, *R*. But a variety of evidence has led to a modification of this simple stimulus-response concept. The first and most essential modification is to introduce a symbol for the organism lying between the stimulus and the response, thus:

S-O-R

The response now appears to be determined by a stimulus acting upon a receptive organism. Some notion of the influence of the state of the organism may be obtained from an experiment by Hamilton (*239*). He set out to compare the influence of positive and negative incentives, or rewards and punishments, upon achievement, a problem that has long defied solution. The difficulty has lain in the fact that one cannot equate rewards with punishments so that it is possible to say "This reward as a reward is equal in strength to that punishment as a punishment." Any experiment in which the stimuli were not equated in strength should at once raise the question: Were the findings due to the fact that the reward was stronger or weaker than the punishment? Hamilton thought he had circumvented the obstacle very simply by using *identical objective* situations as the reward and the punishment, but changing their effectiveness or their incentive value now in one direction and now in another by his instructions to his subjects. The mere statement that "this bell means punishment for a poor record" or that "this bell means reward for a good record" made it one or the other. A wage increase of 10 per cent may be *accepted* as a reward

for good service, or it may be *rejected* as a device for getting more production out of the worker than the employer is paying for. The objective situation might be called the incentive object, whereas its influence in conjunction with an appropriate internal state would constitute an incentive.

EFFECTS OF INCENTIVES UPON OUTPUT

An incentive, as it has just been defined, will almost invariably influence achievement. Exceptions must be made in those rare instances in which performance is already so near the maximum that the attainment of a higher level is not feasible. Where improvement is possible, the change will be in any direction in which the incitement leads. Mace (*390*) has shown that one may create just the general vague intention to do better, to increase speed, to improve accuracy, to raise the level of both speed and accuracy, or to extend the duration of the performance with corresponding changes in achievement.

Laboratory researches have demonstrated that simple mental functions can be speeded up even in well-practised subjects. For instance, Johanson (*325*) found that merely informing the subjects of their previous records increased the speed of a simple reaction by an average of 6 per cent, whereas the punishment by an electric shock applied to a finger reacting too slowly increased the reaction speed by an average of 14.8 per cent. Hamilton, in the experiment cited above, reduced the average error in the judgment of differences in length (on the Galton Bar) by as much as 50 per cent. Crawley (*121*), by allowing his subjects to see their ergograph records as they were being produced, and by setting a certain level of performance as a goal, increased output of work under certain conditions by as much as 8 to 22 per cent with the former incentive and 13 to 52 per cent with the latter. In all instances Crawley's subjects were supposedly doing their best before the incentive was applied.

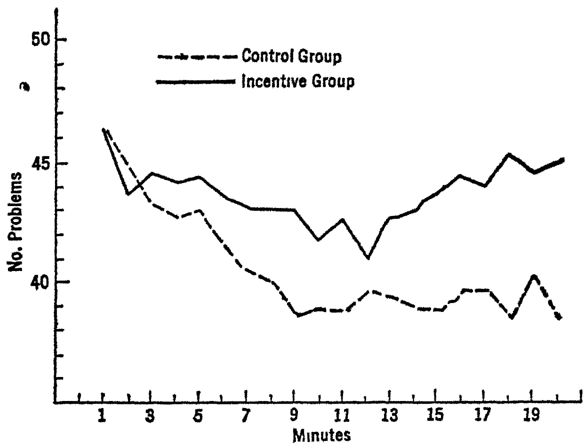
Hurlock (*306*) applied incentives to groups of school children learning arithmetical operations and reported surprising increases in achievement. Praise produced a gain of 75 per cent over a control group working in the usual manner; reproof produced some effect though far less than praise; even hearing other students criticized brought about a slight improvement. Gates and Rissland (*202*) demonstrated a slight but measurable improvement in the performance of simple mental and motor tests by administering praise and reproof.

In addition to the incentive effects already noted, it has been reported by Mace (*390*) that an incentive may delay or prevent entirely the onset of a decrement in output that would normally occur in the

course of a spell of work. In one of his experiments two groups of ten boys each practised the Kraepelin Addition Test for twenty minutes per day for ten days. One group serving as the control was instructed to "do its best to improve" each day, while the other, the incentive group, was instructed to surpass a certain standard of performance set anew for each subject on each day. The curves in Figure 85 give the average performance for twenty minutes on all the days. The dotted line represents the control group and the solid line the incentive group.

FIGURE 85

EFFECT OF INCENTIVE UPON WORK DECREMENT *



* From C. A Mace, "Incentives. Some Experimental Studies," *Industr Hlth Res. Bd. Rep*, 1935, No 72, 23

Whereas the control group shows a pronounced decrement during the first half of the twenty-minute period, followed by a fairly uniform output from that point to the end, the incentive group shows a more gradual fall during the first half of the curve, with a recovery during the second half to nearly the level of the starting point. When the curves are plotted separately for the first and second weeks of practice, similar differences are disclosed. The cases cited are only samples from an extensive and varied literature showing the effects of properly administered incentives. The results are so well established that they form the basis of techniques used in routine school instruction. Industrial field studies will be examined later.

EFFECTS OF VARIOUS KINDS OF INCENTIVES

The devices that may be employed as incitements to greater performance are almost without number. Several of the more commonly used incentives have already been mentioned—urging one to do his

best; keeping him informed of his own progress; giving him some kind of definite goal to aim at; giving him encouragement, blame, or reproof; punishing him for poor performance; and giving specific rewards for good performance. It is not possible to arrange these devices in an order of effectiveness so that it can be said that a certain one will invariably be more effective than any other. The reason for this is that any single incentive situation may vary from very weak to very strong depending upon a number of factors. For instance, a money bonus for a certain level of performance may be an extremely powerful spur to activity if the bonus is large, if it is within reaching distance of the worker, and if by its method of presentation it does not arouse a negativistic reaction. On the other hand, it may be very disappointing in its action if the reward is small, the chance of achievement too remote, or if some circumstance arouses antagonism for any reason at all. In making comparisons, the best that can be done is to describe the specific conditions in detail under which each incentive was employed, with the understanding that the evaluation holds only for those particular circumstances.

Some data furnished by Mace (*390*) confirm these observations. He engaged eighty-eight students to practise certain arithmetical operations for ten minutes per day and four days a week for six weeks. Three sets of working conditions were specified with the students assigned to them as follows:

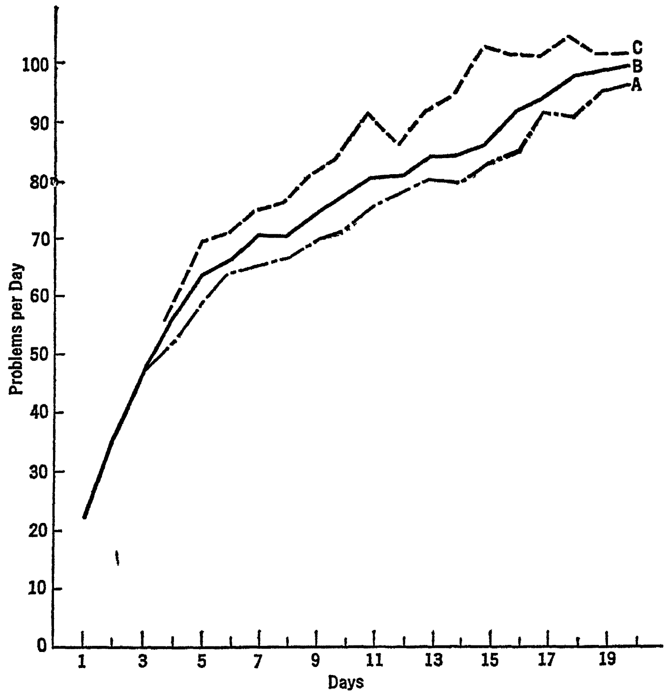
Group A—37 students—to surpass their performance of the previous week.
Group B—37 students—to equal and surpass a fixed standard of seventy computations in the ten-minute period.
Group C—14 students—to do their best.

All subjects worked under the same conditions for the first three days, but on the fourth day they started their special programs. The performance records are shown in Figure 86. The vertical scale indicates average group output per day (ten-minute period) and the horizontal scale shows the test days. Starting on the fourth day when the differential conditions became effective, the curves begin to diverge and follow an independent course from that point. Group C, which is merely trying to do its best, leads the other two groups; next comes the group working toward the fixed goal of seventy problems; and last is the group competing with its own previous week's record. These results are almost exactly the reverse of what would be expected from earlier investigations of incentive and must be interpreted in the light of the specific conditions obtaining in the experiment. The powerful influence of the general instruction to do one's best, in contrast to the weaker force of the specific goal and the knowledge of previous achievement demands justification. Mace attributes it, in part, to the fact that the

goal for Group B was set at a fixed level and was effective mainly in the vicinity of that level. Data presented by him and by others show that raising the goal by an appropriate amount from time to time increases its effectiveness. Most enlightening, however, is his explanation of the performance of Group C, which might have been expected to be

FIGURE 86

DIFFERENTIAL EFFECTS OF INCENTIVES *



* From C. A. Mace, "Incentives: Some Experimental Studies," *Industr. Hlth. Res Bd Rep*, 1935, No. 72.

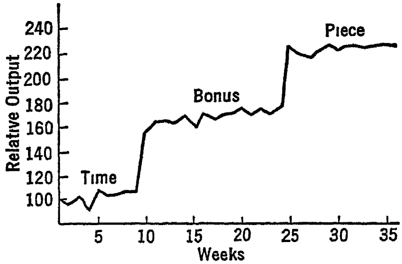
the poorest, certainly poorer than Group A. This latter group was shown its previous week's record in terms of number of problems solved and number of errors. Now, although errors were relatively few and the deductions for them made very little difference in the scores, the subjects were thus made conscious of their errors and consequently directed their efforts toward reducing them, with slight improvement of their scores thereby. Group C had no report of its record in amount done or in errors. It, therefore, was not retarded in its speed by undue attention to accuracy. Furthermore, in attempting to follow instructions to do its best, it did so by setting up some notion of what its previous record was and tried to improve on that. Thus it provided for itself, though less definitely, the same kind of incentive that was given

to Group A, and at the same time was not hampered by the pressure for accuracy. It will be clear to the reader that one cannot generalize from this experiment to the effect that the less specific the incentive the more potent it will be.

The industrial studies of Wyatt (*724*) furnish interesting evidence of the relative influence of three wage systems, time, bonus, and piece. In one of these ten girls, performing various operations, were followed through a period of thirty-six weeks. For the first nine weeks they were paid a fixed weekly wage, during the next fifteen weeks a bonus system was used, and for the remaining twelve weeks a flat piece rate was adopted. The output under these three systems of payment is shown in Figure 87 in terms of the percentage of the time payment taken as 100 per cent (vertical scale). The horizontal scale marks the thirty-six weeks of the experiment. The time payment established a uniform but low level of performance; the bonus created a new and fairly uniform level about 50 per cent higher; and the piece rate brought a new level of achievement some 40 per cent above the bonus level. These are striking changes in performance and testify to the potency of properly administered incentives. Here, as in the material discussed earlier, the exact levels attained and perhaps even the relative effectiveness of the various wage schemes depends upon the particular characteristics of each of these.

FIGURE 87

EFFECTS OF DIFFERENT WAGE INCENTIVES *



* From S Wyatt, "Incentives in Repetitive Work," *Industr. Hlth Res Bd Rep.*, 1934, No 69, 5

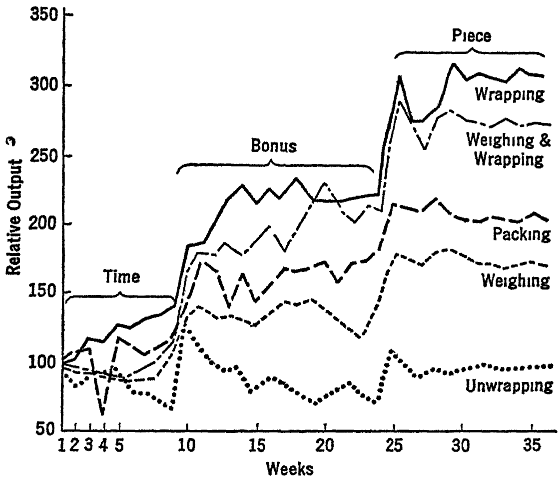
INCENTIVE EFFECTS VARY WITH THE TASK

Considering the sensitivity of the incentive effects to the various conditions under which they are administered, it is appropriate to inquire whether the kind of task would have any appreciable influence upon the outcome. This is a difficult question to answer because the instances of research on various types of work in which change of incentive situation is the only variable are rare. The study of Wyatt (*724*) mentioned above lends support to the suspicion that kind of work is just one more variable that must be controlled for a full understanding of incentives. Ten girls performed each of five different operations in a candy-manufacturing plant, doing one kind of work

on one day per week for thirty-six weeks. Whereas Figure 87 portrays the influence of different wage incentives for the average of all tasks and all workers, Figure 88 breaks these records down into the average of all workers, but for the tasks taken separately. The differences among these curves are striking, since they vary from no influence at all to an improvement of more than 200 per cent. Wyatt's

FIGURE 88

INFLUENCE OF KIND OF WORK UPON INCENTIVE *



* From S. Wyatt, "Incentives in Repetitive Work," *Industr Hlth Res Bd Rep.*, 1934, No. 69, 24.

analysis of the data is particularly interesting from the psychological point of view in that the determining factors appear to reside in the state of mind of the workers. There are, of course, differences in the tasks themselves which might have an influence. For instance, in the number of units of output or of cycles completed in a given time, there is a difference of 40 to 1, unwrapping being the shortest cycle and weighing and wrapping being the longest. They are, in order of cycles completed: unwrapping 40, wrapping 20, packing 12, weighing 6, and weighing and wrapping 1. Thus the operation least affected by incentive stands first, and the one much affected stands second. Wyatt traces the incentive effect to the degree of satisfaction or dissatisfaction with the work. When he obtained from the workers an order of preference for the various operations he found that it correlated almost perfectly with the relative improvement in them and, with the exception of one shift of position, this order is the same regardless of the type of incentive. Thus in still one more instance we find the attitude of the worker rather than the objective situation to be the principal factor in determining what shall be the effect of an incentive program.

It seems, at first sight, that the above findings are the reverse of what might have been expected. A task that is unpleasant, uninteresting, or monotonous ought to be the one that could be speeded up most readily. The incentive should be a compensating influence for these deterrents. It is the expectation of those who use incentives that they will make an intolerable job tolerable, an uninteresting job interesting, and an unpleasant job pleasant, and thereby increase performance. If incentives will not do this, a more fundamental change in the operations themselves may be needed. This question clearly calls for further research.

INDIVIDUAL DIFFERENCES IN RESPONSE TO INCENTIVES

It is to be expected that individuals will differ among themselves in their susceptibility to incentive influences and that the range of these differences will be of the magnitude found for other functions. Even greater variation might be looked for considering the variety of factors that have been found to influence production. Wyatt gives data showing the change of level of performance for each of the ten individuals in the experiment described on page 404. These are reproduced in Table 50 where the figures represent percentage of change

TABLE 50

Individual Differences in Response to Incentives *

Incentives	*Workers*									
	A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*
Time	+ 9 8	+ 6 2	+ 5 5	− 0 3	+11.9	+ 4 2	+16 6	+ 7 8	+ 0 4	+ 3 1
Bonus	+16.2	+ 8 9	+ 3 6	+ 2 9	+17.0	+ 8 1	+15 3	+ 2 3	+ 1 8	+ 1 9
Piece	+ 3 6	+ 4 2	+15 1	+13 0	+ 4.1	− 2 1	+ 5 7	− 8 0	− 7.5	− 7 3

* From S Wyatt, "Incentives in Repetitive Work," *Indust Health Res Bd Report*, 1934, *69*, 12.

in output from the first three weeks of any one wage system to the last three weeks of that same system. That is, the data do not show the initial effect of introducing a new incentive, but the effect upon improvement during the course of any one wage program. Thus the entry of + 9.8 for worker *A* under a time payment means that while that payment system was in force he gained 9.8 per cent. The next figure, 16.2, means that while the bonus system was in effect he gained 16.2 per cent. Reading across the first row of figures in this table one sees the way in which the ten individuals varied in their performance under time payment, plus meaning improvement and minus meaning deterio-

ration. The range here is from —.03 to + 16.6. Similarly, for the bonus system the range is from + 1.8 to + 17.0 and for the piece rate from — 8.0 to + 15.1. A brief inspection of the columns in the table shows that individuality expresses itself in the differential reaction to the several modes of payment. Thus worker *A* made his greatest gain under a bonus, *C* under a piece rate, and *H* made his greatest gain under the time rate.

THE COST OF INCENTIVES

There seems to be a tacit assumption underlying the use of incentives that when improvement occurs it is to be interpreted as an increase in efficiency. Now such is the case only if output is accepted as the measure of efficiency and cost is either disregarded or assumed to remain constant. It will be evident from earlier discussions (Chapter 7) that cost can neither be disregarded nor assumed to be constant. There are circumstances in which cost will be reflected in output, as, for instance, when cost to the human organism is so excessive that a given level of output cannot be maintained. But if one really sought to measure efficiency of human work, he would have to charge changes of cost against changes of output even where the amounts of the former were not excessive. It is legitimate, therefore, to inquire whether incentives as commonly employed increase efficiency as defined in Chapter 19.

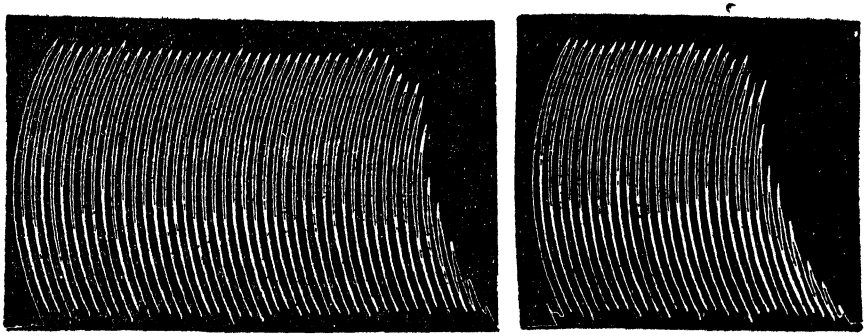
An investigation by Vernon (*660*) of the production records of men engaged in heavy work shows that not all increases in output can be accepted as increases in efficiency. Six men were lifting, loading, transporting, and unloading cases of tea, each weighing about 130 pounds. They worked eight and one-half hours per day for the first five days of the week and four hours on Saturday. Before a bonus payment system was introduced a man handled an average of 156 cases per day and the level of performance was fairly uniform over a period of sixteen weeks. After a bonus was introduced for all cases handled above a certain minimum, the output rose until at the end of thirteen weeks the level had risen to 323 cases per day. At this point the record began to fall, and within a week became stabilized at about 270 cases per day. It could not be raised again to its former maximum. Investigation of the workers showed that they had been overtaxing themselves, creating a strain that appeared to be serious. A reorganization of the whole work program followed this inquiry, with the result that without undue effort about 300 cases could be handled per day. An adequate measure of efficiency applied to this work situation could have revealed the point at which growing cost per unit of work made further increases in output inefficient.

INCENTIVE COST IN TERMS OF RECOVERY RATE

In order to avoid the complicated and difficult techniques involved in measuring the cost of work directly in terms of energy consumed, Crawley (*121*) adopted a method of measuring the cost of incentives that was somewhat analogous to the measurement of memory by the "saving method." In that method the subject learns an assignment to a given level of proficiency and, after a stated interval too long to permit a perfect recitation, relearns the material. The difference between the learning and the relearning (in terms of number of repetitions) is a measure of what was retained over the interval. Two methods of learning, for example, concentrated or distributed learning, may thus be compared in efficiency in terms of the amounts retained. In the adaptation of this technique to the incentive problem the worker performed on an ergograph until he could work no longer, then rested for a standardized period too short for complete recovery, and finally worked again under exactly the same circumstances as at first. The difference between the output during the first and second work periods would show the amount of decrement caused by the first work period that could not be recovered from in the rest interval. Now if, on another occasion, an incentive were to be introduced into the first work period, the decrement from that period would be reflected in the second work period. If, then, one were to compare the decrement under standard conditions with the decrement under incentive conditions, the difference should be due to the incentive which is the only new variable introduced. Figure 89 shows such a pair of work curves obtained on an arm ergograph when the load to be lifted was fifteen pounds and

FIGURE 89

Two Work Curves Made under Identical Conditions with a Four-Minute Rest Interval Between Them *



* From S L Crawley, "An Experimental Investigation of Recovery from Work," *Arch. Psychol.* (New York), 1926, No 85, 25.

the rest interval was four minutes. Casual inspection indicates that the first work period caused a decrement of some sort which shows in the smaller second work period.

Two kinds of incentives were employed by Crawley. One of these consisted in allowing the subject to see his ergograph record as it was being recorded on the kymograph drum; the other consisted in the addition of a horizontal line on the record serving as a goal which the

TABLE 51

EFFECTS OF INCENTIVES UPON OUTPUT *

			Control	*Results Visible*	*Results Visible Goal*
Subject A	10 lbs.	First work curve	100.0	106.0	135.8
		Ratio 2nd to 1st	49.5	42.4	31.0
	15 lbs.	First work curve	100.0	107.6	131.6
		Ratio 2nd to 1st	83.4	62.9	38.2
	20 lbs.	First work curve	100.0	118.8	138.0
		Ratio 2nd to 1st	92.0	74.5	57.2
Subject B	10 lbs.	First work curve	100.0	128.8	138.1
		Ratio 2nd to 1st	53.4	29.0	27.1
	15 lbs.	First work curve	100.0	112.1	135.4
		Ratio 2nd to 1st	71.4	58.9	43.7
	20 lbs.	First work curve	100.0	144.1	150.0
		Ratio 2nd to 1st	114.0	68.0	62.3
Subject C	10 lbs.	First work curve	100.0	122.6	112.9
		Ratio 2nd to 1st	43.7	29.1	35.3
	15 lbs.	First work curve	100.0	116.6	113.4
		Ratio 2nd to 1st	62.9	38.7	46.9
	20 lbs.	First work curve	100.0	114.2	143.4
		Ratio 2nd to 1st	95.5	82.7	56.9
Subject D	10 lbs.	First work curve	100.0	110.0	126.3
		Ratio 2nd to 1st	42.5	36.5	27.7
	15 lbs	First work curve	100.0	115.7	120.8
		Ratio 2nd to 1st	65.4	55.1	50.9
	20 lbs.	First work curve	100.0	114.6	132.4
		Ratio 2nd to 1st	107.3	85.2	72.0

* Adapted from S. L. Crawley, "An Experimental Investigation of Recovery from Work," *Arch. Psychol* (New York), 1926, *85*, 40.

subject should try to reach. Coefficients of correlation between output in the first and output in the second work period for all subjects and for the various work conditions are all negative, and many of them are large, ranging from —.46 to —.90. They mean that a large output in the first work period tends to be followed by a small one in the second work period and vice versa. This is true whether the large output in the first work period is caused by the use of an incentive or not. A sample of the data obtained on the arm ergograph with a rest period of two minutes between the work periods is given in Table 51. The results for control, results visible, and results visible with goal, are given in the last three columns, where each figure is based on three work curves. There are four subjects, *A, B, C,* and *D,* each of whom lifted a ten-, fifteen-, and twenty-pound weight. For each weight two rows of figures are given. The first row shows the work done by each work method in terms of percentage of the control, which is taken as 100. The second row gives for each work method the ratio of the work done in the second work period to that done in the first. Thus subject *A* did 106.0 per cent as much work when his results were visible as in the control. In the control he did 49.5 per cent as much in the second work period as in the first, and with "results visible" he did 42.4 per cent as much in the second work period as in the first. Inspection of this table will show that the incentive produced an increased output in every one of the first work periods, and that in every case but two the visible goal was more effective than just the visible record When-ever the incentive did produce an increased output in the first work period, there followed a decrease in the output in the second work period. In so far, therefore, as the logic of this experiment is acceptable, the conclusion may be drawn that the gain from the use of incentives is not necessarily to be interpreted as an increase in efficiency but may, on the contrary, leave a second work-curve decrement chargeable against the first work-curve output. The amount and seriousness of this decrement would have to be determined for each case.

INCENTIVE COST IN TERMS OF METABOLIC RATE

The method employed by Crawley is at best an indirect attack upon the problem of incentive cost and does not obviate the necessity for a more direct attack upon it. This has been attempted by Poffenberger and Rounds,* who measured the cost of work in terms of oxygen consumption, employing a technique resembling that to be described in the next chapter. The work consisted of arithmetical computation. Sub-

* A. T. Poffenberger and G. H. Rounds, "Metabolic Cost of Incentives" (unpublished).

jects were paid an hourly stipend, and a money bonus for output beyond a certain level constituted the incentive most commonly employed. The results of this study furnish striking evidence for the dependence of the incentive response upon the attitude of the worker as well as upon factors in the objective situation. This is so much the case that each individual performance record becomes unique and cannot be combined statistically with others without loss of meaning. Among these "case records" there are instances in which the incentive produced increased output accompanied by increased metabolic rate, decreased output with increased metabolic cost, and decreased output with decreased cost. They are unintelligible when divorced from the introspective reports that were associated with them. Of most interest, of course, are the cases in which the incentive created a genuine increase in efficiency, meaning higher output and lower metabolic rate. The introspective reports in these instances show a complete freedom from distracting influences of an objective or subjective sort, a complete absorption in the task such that the worker is oblivious of his surroundings. There is no awareness of the bonus as the end to be attained, but rather the activity seems to be an end in itself. In the cases where increased output is accompanied by increased metabolic rate, the worker knows that he is working against resistance, and even the bonus crowds into his field to compete with the work itself. Recent work of Davis (*128*) (*129*) on muscular tension during work under distraction, described in Chapter 7, lends support to the suspicion that the former condition will be characterized by relative freedom from muscle tension, whereas the latter will show an excess of such tension. Differences in muscular tension might well be related to the differences in metabolic rate. What makes this perfect adjustment in some cases and not in others remains an unsolved problem. Every worker knows that at times he has such lucid periods when, in the absence of any artificial incentive, his achievement reaches a high level.

MAKING INCENTIVES EFFECTIVE

Although there is much that is still unknown about the mechanism of incentives, there are a few facts that are sufficiently well established from the researches on animals, children, workers in the laboratory and in the field to have attained the status of rules. Some of these will be mentioned.

1. Whatever the nature of the incentive may be, the consequence to the individual should be immediate rather than remote. Waiting for one year for the bonus that has been earned makes it less effective as a spur to action than it would be if it came in a month, a week, or a day. However, the units

should not be so small that the reward per unit appears to be not worth striving for.

2. The reward or the punishment should be certain in order to be most effective Suspicion from any source whatever that the results may not be forthcoming weakens the effect of the incentive.
3. The incentive plan should be simple enough to be readily understood. Uhrbrock (*655*) cites instances in which incentives not only failed in positive results but actually aroused antagonism because they were too complicated to be understood or were misunderstood by the workers.
4. The return for added effort should be easily computed by the worker. Whatever the payment system, it should not require the application of complicated formula by a statistician. The best results may come from a scheme so simple that the worker can tell just what difference every added unit of output will make to him at the moment he adds the unit.
5. The reward should be within the reach of the worker. If set so high as to appear unattainable it may create discouragement, rather than incite to increased production.
6. It must be remembered that attitude of mind is an essential part of the incentive picture and that as much attention should be given to establishing proper attitudes as to setting up proper wage systems.
7. Output is not an entirely safe measure of the effect of incentives. Watch must be maintained for signs of increasing cost or increasing dissatisfaction that may eventually make the incentive program fail.

23

Reducing the Cost of Work

The efficiency of an activity can be increased as readily by decreasing the cost per unit of work as by increasing the number of units of work. Major attention has always been paid to the latter because output is relatively easy to measure whereas cost is relatively difficult to measure. This is especially true in the case of human efficiency. Although great progress has been made in recent years in the techniques of measuring human energy expenditure, the methods are complicated and not well suited to the industrial situation (*480*). Where they cannot be conveniently used, some other less direct measure is generally employed, such as those discussed in Chapter 6, and the one of these most commonly used is output. When as many factors as possible are held constant in the work situation, a falling off in output is interpreted as resulting from increasing cost.

As pointed out in Chapter 6, there are at least two dangers in this substitution of output for cost. First, there may be a reduction of output merely through loss of interest or through carelessness. Care must be taken, however, to be sure that these very changes are not themselves indicators of increasing cost. Second, there may be no decrease in output, when there otherwise would be, because a certain level is maintained through the use of incentives, and with a probable increase in energy expenditure.

The effort required to perform a given task is sometimes employed as an indicator of cost. In physical activities it would seem that effort is evidence of muscular strain, hence to work with greater effort would mean to work less economically. But to measure effort is a difficult matter, unless introspective report of effort be accepted as adequate.

The following discussion of economy of work will draw upon many techniques in addition to the direct measures of cost in terms of the energy expended by the organism in doing work. In general it may be said that there are two ways in which economy of work may be in-

creased, namely, by reducing the effort required to do the work itself, and by establishing the proper relationship between work and rest. The effort required to accomplish a given end may be reduced by choice of the appropriate tools and machines, by proper adjustment of the worker to them, and by choice of the correct movements.

ECONOMY THROUGH THE CHOICE OF PROPER TOOLS AND EQUIPMENT

Especial attention should first be directed to the matter of providing the worker with the most efficient mechanical devices. Industry and business have gone far in this respect, and research is regularly concentrated upon the improvement of tools and machinery (*26*). Investigation shows that there are still surprisingly large differences in the human work required to operate various brands of machines that are marketed for accomplishing the same purpose. Careful search may be

TABLE 52

THE WORK REQUIRED TO TYPE AVERAGE LETTERS ON FIVE DIFFERENT TYPEWRITERS *

Make	*Letter Keys*	*Space Bar*	*Shift Key*	*Line Space*	*Carriage Return*	*Total Work*
A	33 6	5.2	5.4	21.2	32 2	98
B	53 8	3.0	5 8	14 1	34.0	111
C	42 4	3.8	3.8	17 8	32 4	100
D	45 2	3.6	4 2	10.8	35 8	100
E	29 8	2.8	4 8	16.8	27 2	81

* Adapted from H F. Norton, "The Work Required to Operate Several Makes of Typewriters," *Trans Amer. Soc Mech Eng , Management,* 1928, *50,* 29-36, 36

needed to find among these the most efficient one. For instance, Norton (*469*) reported a study of five makes of typewriters all purchased in the open market and among which there was a great variation in the ease of operation. He measured, separately and by a technique that need not be described here, the physical work required to depress the letter keys, the space bar, the shift key, and the line spacer, and to actuate the carriage return. His average figures for five machines of each of the five makes of typewriters, named *A, B, C, D,* and *E,* are shown in Table 52, in which the entries show the work done in ergs divided by 10,000.

The author points out several significant matters which are not apparent from the table. There is a great variation in efficiency among the

finger of the right hand carries 135.8 per cent of the ideal load, whereas the second finger of that hand carries only 58.4 per cent of the load for which it is adapted. The second finger of the left hand is overloaded as much as that finger of the right hand is underloaded. The

TABLE 53

LOAD ON FINGERS DURING TYPING *

Finger	Percentage of Ideal Load: Right hand	Left hand
1	135.8	149 3
2	58.4	153 0
3	100.5	73 1
4	30.6	93.9
Average load	81.3	117 3

* Adapted from R E Hoke, *The Improvement of Speed and Accuracy in Typewriting* (Baltimore, Johns Hopkins University Press, 1922)

right hand as a whole has lighter duties, and the left hand has heavier duties, than it is capable of performing. Hoke (*264*), Dvorak, Merrick, Dealey, and Ford (*153a*), and others have proposed reorganizations of the typewriter keyboard to accord with the disclosures of research, but none of these investigators has thus far been able to overcome the inertia of long-established tradition in favor of the "standard" keyboard.

ECONOMY THROUGH PROPER POSITION OF THE WORKER

It frequently happens that unusual and tiring movements are necessitated by the improper height or arrangement of working material in relation to the worker. In one case, a slight change in the height and slope of a work-table enabled girls engaged in sorting and filing cards to increase their output by about 50 per cent with no decrease in comfort. In another case, small alterations in the operation and arrangement of the machinery decreased working time almost half without increase in fatigue.

Many of the spectacular increases in efficiency reported by the Gilbreths (*207*) are owing to just such changes. They recognized the value of a comfortable adjustment of the body posture during work and constructed chairs to place the worker in exactly the correct relation to

FIGURE 90

Arrangement for Typing: Left, While Seated; Right, While Standing *

* Obtained through the courtesy of L M Gilbreth

his work. They saw the necessity for a shift of body posture occasionally in order to relieve strained muscle groups, and devised tables and chairs that would permit efficient work while the operator is either standing or sitting. One of the most interesting of such arrangements is the desk and chair, arranged for a typist as shown in Figure 90. The legs of the desk have been lengthened so that the typist, when standing, is just at the right height for her work. The chair is fastened upon a small movable platform that makes the sitting height correct. The worker can, therefore, stand or sit as she pleases by moving the platform back and forth. Although no actual data are at hand to show the value of this device, it is reported both to increase output and to reduce fatigue materially. The writer is informed that the unique desk and chair were never widely adopted because of the strength of tradition in favor of the customary arrangement and the "strange" appearance of the new one. Even in this age of efficiency, tradition, especially as it concerns the attitude of the worker in office and shop, is a serious obstacle to the introduction of improved methods of work.

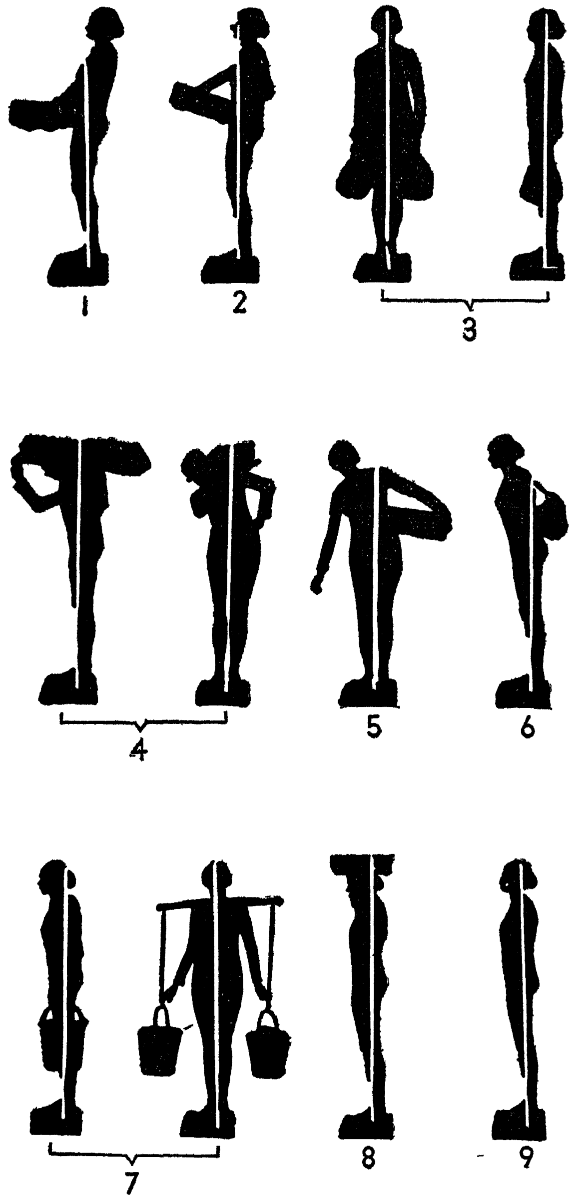
ECONOMY OF DIFFERENT METHODS OF CARRYING LOADS

One of the most interesting studies of the effect of posture upon the cost of work was made by Bedale (*33*) in terms of energy expenditure. By means of a portable respiration calorimeter, he measured the oxygen consumed per kilogrammeter of work. The worker carried loads varying from twenty to sixty pounds over a circular route one hundred yards in length. Although walking was continuous at a fixed rate of speed, the worker was under load only every alternate trip around the circuit. Such an arrangement, as well as the size of the loads carried, was chosen in order to resemble as nearly as possible the regular industrial working conditions. Eight postures, all of them suitable for carrying certain commodities, are indicated in the diagrams of Figure 91 and were as follows:

1. Tray carried in front of the body
2. Tray carried in front but with the weight taken off the arms by a strap around the shoulders and fastened to the corners of the tray
3. Weight tied in equal bundles and carried at the sides of the body in either hand
4. Weight distributed over a board carried on left shoulder
5. Weight carried in tray on left hip
6. Weight carried in a rucksack
7. Weight divided equally between two pails and carried on a shoulder yoke
8. Weight carried in a tray upon the head
9. Normal posture

FIGURE 91

Postures Assumed in Carrying Loads *

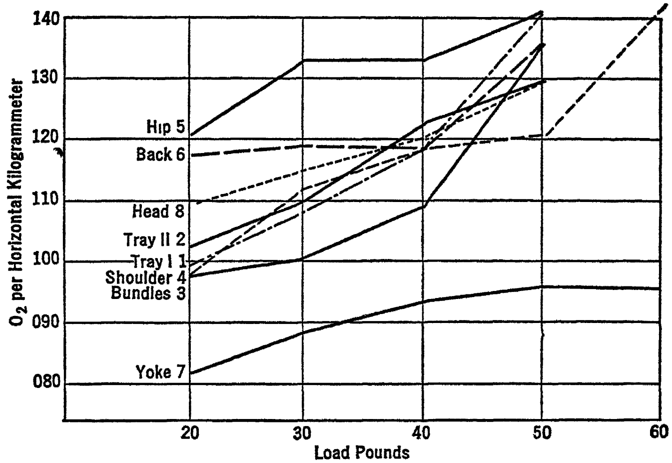


* From E. M. Bedale, "Comparison of the Energy Expenditure of a Woman Carrying Loads in Eight Different Positions," *Industr Fat Res. Bd. Rep*, 1924, No 29, 27

igure 92 gives the records for metabolic cost in the form of curves. vertical scale is in units of oxygen consumed for each horizontal grammeter of work, that is, one kilogram carried forward a dis-e of one meter. There is a separate curve for each method of ying and these are named at the left of the chart. The different 's are shown along the base line of the chart.

FIGURE 92

OXYGEN CONSUMED IN CARRYING LOADS*



dapted from E M. Bedale, "Comparison of the Energy Expenditure of a Woman Carrying Loads ;ht Different Positions," *Industr. Fat. Res Bd Rep*, 1924, No. 29

hat method is found to be the most efficient which gives the most ·ly normal body posture, allowing thereby the greatest freedom of chest in breathing, interfering least with the gait, and creating the t local strain. The relative importance of these several factors is not known. The yoke method is by far the best as the curve is the ɜst for all loads. Inspection of the posture chart shows that the y maintains a normal position by this method. For all the other hods there is a relatively large increase in cost per unit of work ither forty or fifty pounds of load. Thus the tray I, the back, and bundle methods become uneconomical when the load is over forty nds, and the shoulder method when the load is over fifty pounds. least economical method is carrying the weight on the hip. An nination of the posture chart will bear out these conclusions except the bundle method, which is inefficient because of local strain in wrists rather than in the distortion of posture, and for the head hod, where constriction of the chest muscles was the dominant or.

This experimental study is important because it shows the feasibility of measuring the energy consumption directly while work of an industrial sort is in progress, and also because it shows how complex the weight-carrying problem is, since the efficiency varies not only with the method of carrying but with different weights for a given method.

ECONOMY IN WHEELING A BARROW

The research of Crowden (*122*) upon the energy cost of wheeling a barrow will serve as a final example of the significance of both correct posture and correct movement for the reduction of energy cost of work, and will at the same time suggest the flexibility of the energy-measuring techniques for the analysis of the cost of separate stages of a task. The equipment and method of energy measurement may be seen in Figure 31, facing page 116. Of all the many aspects of the problem that were studied by Crowden, only that one concerned with the actual process of wheeling the barrow will be examined.

The operation was broken down into three parts as follows: a gravity factor, raising and lowering the barrow handles; an acceleration factor, attaining speed and stopping; and a velocity factor, maintaining the desired speed. The cost of the various part operations was determined as follows.

Wheeling a distance of 150 meters with one start and one stop cost 3,560 cubic centimeters of oxygen, whereas wheeling 10 meters' distance with one start and one stop cost 639 cubic centimeters of oxygen. Therefore, the difference of 2,921 cubic centimeters between these two costs indicates the cost of wheeling a distance of 140 meters. The cost of wheeling 10 meters is then readily found to be 208 cubic centimeters. If this amount is now deducted from the cost of 10 meters with one start and one stop, it will appear that one start and one stop will cost 431 cubic centimeters of oxygen. Now this starting and stopping includes both raising and lowering the barrow handles and acceleration. A supplementary experiment showed the cost of raising and lowering the handles to be 114 cubic centimeters, leaving 317 cubic centimeters for the cost of the acceleration alone. Crowden thereupon computes that for wheeling a load a distance of 50 meters the following costs could be assigned:

Gravity—114 cubic centimeters of oxygen (7.75 per cent of total cost)
Acceleration—317 cubic centimeters of oxygen (21.55 per cent of total cost)
Velocity—1,040 cubic centmeters of oxygen (70.7 per cent of total cost)

The first two stages thus account for about 30 per cent of the cost. Hence the more frequent the stops, the greater the cost, from which it

follows that for the greatest efficiency, the working set-up, including load, and so forth, should be such that the total distance to be traversed could be negotiated without an intermediate stop.

ECONOMY THROUGH PROPER DISTRIBUTION OF EFFORT

The cost of work, however that cost is measured, may be considerably reduced by establishing a proper relationship between work periods and rest periods. The material presented in Chapter 6 gives at least a theoretical justification for a study of work-rest schedules. The curve constructed from Mosso's ergograph experiment (Figure 30) shows an increasing cost per unit of output as the work progresses. It appears that the first half of the work is accomplished with as little cost as the last 10 per cent of the work. This would mean that a unit of work at the end of the curve is about five times as costly as one at the beginning of the curve. On the other hand, there would have to be set off against this increase in cost, the increasing output in the early portion of the curve, which is attributable to the warming-up process. Here then are at least two factors, discovered from the measurement of output and of recovery, upon which an efficient work curve will depend.

Measurement of the metabolic cost of work gives still further theoretical justification for attention to the work-rest relationship. Increased cost occurs when the equilibrium between the processes of waste and repair is disturbed beyond a given degree. Work is most economically done when a proper balance is struck between them, a condition which is technically known as the "steady state."

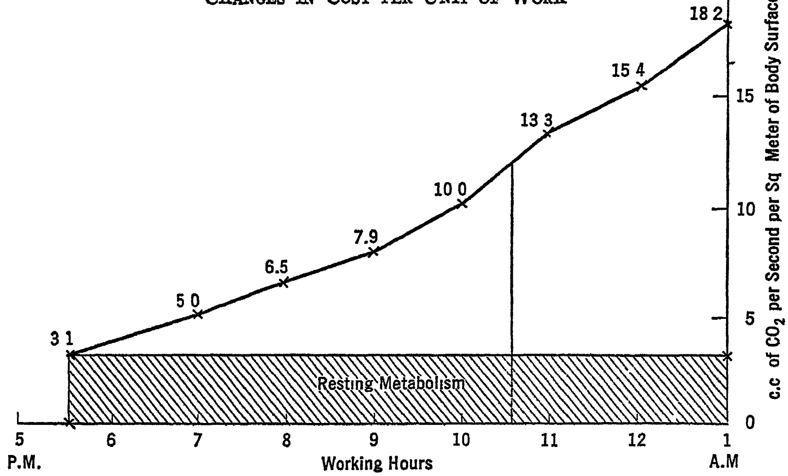
Schubert (*541*), in an experiment referred to on page 117, attempted to measure the metabolic cost per unit of physical work at various stages of the work curve. He tried to establish a work curve that a worker, after practice, could repeat day after day; to divide the work curve into fourths; and to compare the metabolic cost per unit of work in each of these fourths. The only work program that would hold steady on successive days was one in which the load, tempo, and duration were such as to enable the worker to maintain a uniform output. Change of cost was, therefore, sought in the metabolic rate alone.

It appeared in this particular experiment that the conditions which produced a steady output also produced a "steady state" in the worker so that cost per unit of work did not change *or at least changed very little.* This last qualification is made necessary by the nature of the measure of the metabolic process. It happens that the cost of a given work period cannot be determined merely from the oxygen consumed

during that period, for the organism goes into oxygen debt which is repaid or made up in this experiment during the succeeding rest period. The reality of this oxygen debt will be obvious in the case of a runner of a hundred-yard dash. He holds his breath during the race so that whatever oxygen he has used must be replaced after he begins again to breathe. When Schubert measured the repayment of this oxygen debt during rest following the work, he found only a slower rate of repayment for later portions of the curve rather than a greater debt to be paid. Laboratory experiments of this type show that work conditions can be arranged so that a uniform performance is possible in terms of output and cost. Failure to meet these conditions will bring reduced output and increased cost.

FIGURE 93

CHANGES IN COST PER UNIT OF WORK *



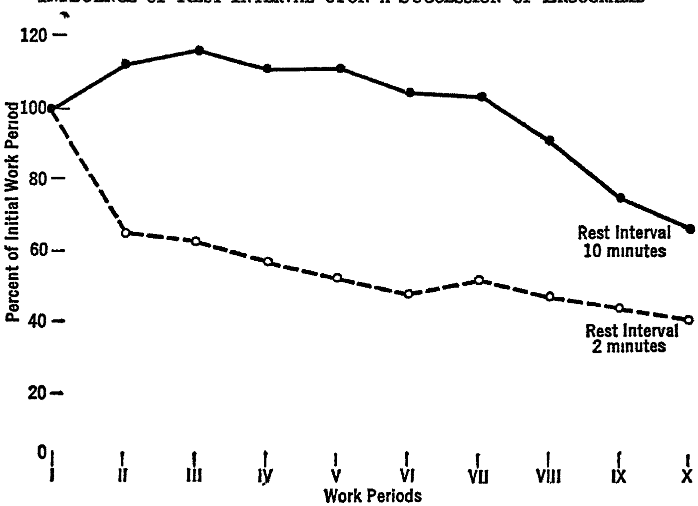
* Adapted from A D Waller, "The Physiological Cost of Work in Various Departments of the Times Printing House," *J Physiol*, 1920, *53*, CV as modified by R. M. Page, "On Supplanting the Industrial Fatigue Concept," *J Business*, 1929, *2*, 144.

The metabolism measurements made by Waller (*481*) (*675*) support the expectation of increasing cost per unit of work in the latter part of a work spell. He measured the metabolic cost in terms of carbon dioxide exhaled per second by night workers in the various departments of the *London Times* Printing House. The technique of measurement was similar to that already described. The pertinent results for the typecasting department are given in Figure 93 in which the abscissa shows the working hours from 5 P.M. to 1 A.M., and the ordinate is a scale representing cubic centimeters of carbon dioxide per second. The striped section along the base line indicates a resting requirement of approximately 3 cubic centimeters per second. If the area under the curve

which is an average of twelve nights, be divided vertically into two equal parts, the dividing line will fall at about 10:30 P.M. This means that from 5:30 to 10.30 P.M., a period of five hours, the same amount of energy was expended as from 10·30 P.M. to 1 A.M., a period of two and one-half hours. Assuming that output of work was uniform over the whole work spell, an hour in the latter part of it would be nearly twice as costly in energy expended as an hour in the early part. Curves for other types of work in the Printing House do not, however, show the same increment of cost. In fact, the discrepancy in cost between early and late hours varies from none whatever for the proof-

FIGURE 94

INFLUENCE OF REST INTERVAL UPON A SUCCESSION OF ERGOGRAMS *



* Adapted from C W Manzer, "An Experimental Investigation of Rest Pauses," *Arch. Psychol.* (New York), 1927, No. 90, 60 and 71.

reading department to the case just described which is the maximum. The determining factor, according to Waller, seems to be the amount of muscular activity involved in the process.

The laboratory experiment of Manzer (*394*), cited in Chapter 6, shows the effects of varying lengths of rest pause upon output. Some of his data for one subject are presented in Figure 94. All of the conditions are the same for the two curves except that in the one case the rest interval between ergograms in ten minutes and in the other it is two minutes. The arm is rhythmically lifting a weight of 13.6 kilograms. With the ten-minute interval, the output actually increases during the greater part of the curves, whereas with the two-minute interval there is a decrease of about 35 per cent in the second work spell and a more

gradual decrease from that point. It may be surmised that such a load, rhythm, and rest interval could be found for this subject that his performance would not fall below its initial level over a long series of work spells (steady state).

An additional study by Shepard (*559*) will be mentioned because it approximates the industrial situation rather closely and because it offers evidence concerning both output and energy cost. He employed a person to work approximately a nine-hour day at what he called light-heavy muscular work. It consisted in raising and lowering a pair of chest weights—the actual load on each arm being 8.4 pounds—by walking to and from the point of attachment of the device. Although the load was too light to produce muscular strain, it was raised and lowered so often that the worker became sensibly fatigued by the end of the day. All circumstances under which the work was done were kept as constant as possible. Conditions of quiet, temperature, and humidity were more uniform and favorable than under ordinary factory conditions, and any deviations from good conditions were noted. In one section of his study, the work periods varied in length from twenty-five minutes to sixty minutes, whereas the rest period was always eight minutes.

TABLE 54

THE OPTIMAL RELATION BETWEEN WORK AND REST *

Length of Work Period	*Length of Rest Period*	*Average Foot-Pounds of Work per Hour*
25	8	88,232
30	8	96,880 †
35	8	98,237
40	8	97,600 †
45	8	98,712
50	8	96,600 †
55	8	95,730
60	8	94,823

* Adapted from G. H. Shepard, "Fatigue Experiments at Purdue University," *Indust. Management*, 1921, *62*, 281; and *63*, 354.

† Low temperature and high humidity.

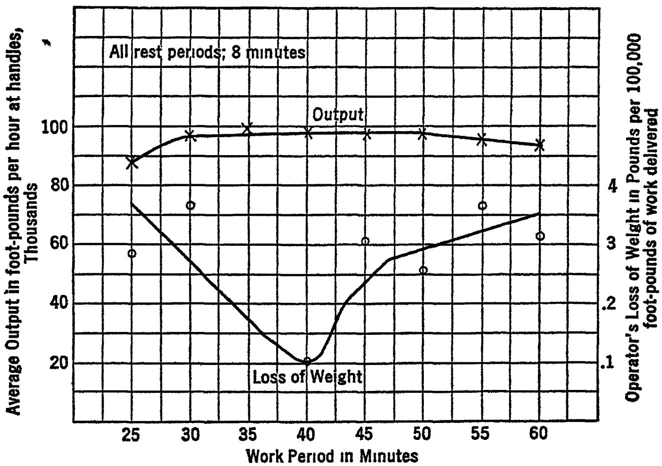
The results of these different combinations of work and rest are given in Table 54. The first column gives the length of the work period in minutes and the third gives the foot-pounds of work done per hour. It should be noted that when three of the schedules were in operation there was a condition of low temperature and high humidity, to which the author attributes a loss in efficiency. The maximal production was obtained with a work period of forty-five minutes and a rest of eight minutes, when no account was taken of energy expendi-

ture. Essentially the same results were obtained in another section of the experiment where the rest periods varied and the length of the work period remained constant.

The inspection of Figure 95 shows a further interesting and important fact. In addition to a curve constructed from the figures of the table (with slight corrections for unfavorable environmental conditions as noted), there is plotted a curve showing the loss of weight of the worker per unit of work done. From this it appears that loss of

FIGURE 95

EFFECT OF DIFFERENT WORK AND REST SCHEDULES UPON OUTPUT AND LOSS OF WEIGHT *



* From G. H. Shepard, "Fatigue Tests at Purdue University," *Industr. Management*, 1921, *62*.

weight, which the investigator takes as an indicator of energy expenditure, is not directly correlated with output, but depends upon the relation between work period and rest period. As in cases which we have considered before, the amount of work done is, when taken alone, not an entirely safe index of efficiency. Taking loss of weight into account, the forty-minute work period with the eight-minute rest period gives the most effective schedule. Such is certainly the case where the job is to be continued over a long period.

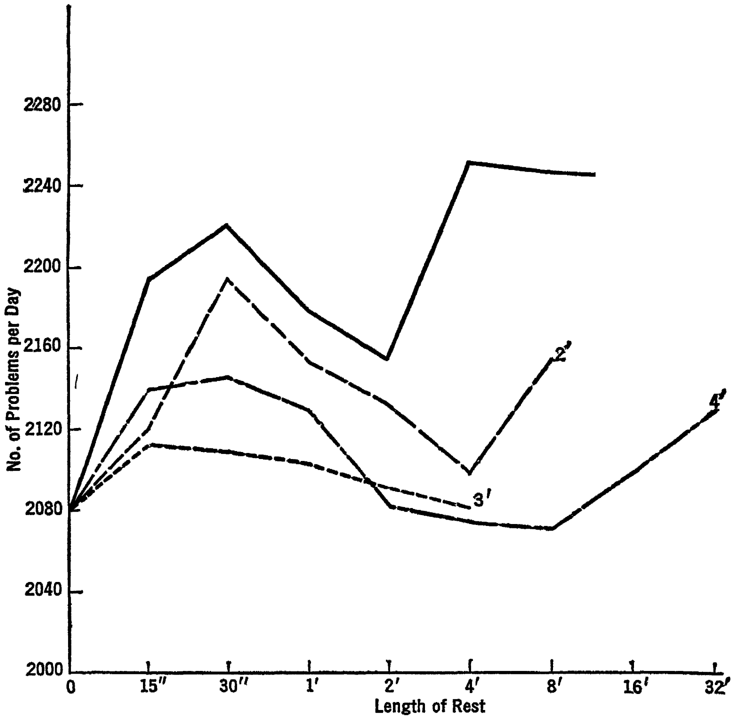
DISTRIBUTION OF MENTAL WORK AND REST

Shepard concluded from his study, and verified the conclusion in later work (*558*), that for light-heavy industrial work of this sort about one-sixth of the time should be spent in rest. The point that is particularly significant is that the schedule that gives the best results, the

optimal program, is not the one that allows the largest proportion of rest nor the smallest proportion of rest, but is one that lies about midway between these extremes. The same conclusion is reached in regard to the relation between work and rest in mental activities. Phillips (*494*) investigated a series of work and rest schedules for the process of high speed continuous multiplication of single digits by single digits. The subjects were four boys twelve to fourteen years

FIGURE 96

WORK AND REST SCHEDULE FOR MENTAL WORK *



* Adapted from G E Phillips, "Mental Fatigue," Forbes College, Sydney, Australia, *Records of the Educational Society,* 1920, No 40, 30

of age, engaged by the week and paid a wage supplemented by bonus payments. The experiment lasted for twenty-four days, each comprising twelve minutes of work, with work periods of one, two, three, or four minutes, and with rests of thirty seconds to thirty-two minutes between work periods. The results of this experiment are shown graphically in Figure 96, where there are four curves, one for each length of work period, where the abscissa indicates the rest periods, and where the ordinate indicates the average number of multiplications per day. A high output occurs for all work periods with a rest of fifteen to

thirty seconds. Longer or shorter rests seem to reduce the amount done, except that when the rests are four minutes or longer, the output again rises and may reach a second high point. The author explains his findings as a result of the competition of two sets of factors, one set which he calls fatigue, a retarding factor, and the other set which he calls incitement. Too much rest may be just as uneconomical as too little in both mental and physical work.

The optimal relationship between work and rest is very sensitive to changes in the conditions of the work. The schedule for handkerchief folders that was worked out by Gilbreth and is described in Chapter 6, allowed one-fourth of the total time for rest and was responsible for a large increase in efficiency. But the schedule was found to hold for plain white handkerchiefs only When black-bordered ones were folded, the onset of fatigue was much more rapid and a still larger proportion of the total time had to be spent in rest. This case affords an illustration of the fatiguing effects of strong contrasts of light and shade, especially when they are moving within the field of vision. Although work and rest schedules need modification to meet slight changes in working conditions, almost any schedule that introduces rest pauses in long stretches of work will raise the efficiency somewhat. There is little or no danger, outside of the laboratory, of increasing the length and number of rests beyond the optimum.

FIELD STUDIES OF WORK AND REST SCHEDULES

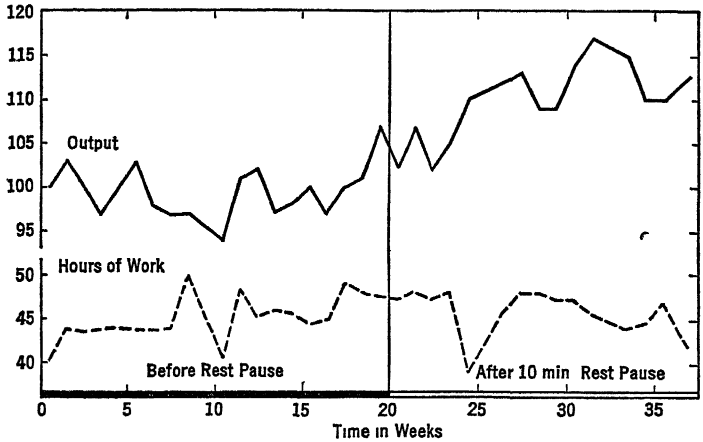
Field studies of this nature, lacking the control of conditions that is customary in the laboratory, must be interpreted with caution. There are so many factors that play a part in changes of production, such as slight differences in the work, temperature, humidity, and lighting conditions, systems of payment, and even the character of the workers themselves, that the cause of any change cannot be readily found.

Some of the variables can be eliminated by following the same group of workers through a series of changes in work schedule, because most of the circumstances will then remain the same. Such a field study has been made of light industrial work by Vernon and Bedford (*664*) in which a special effort was made to reduce variation in working conditions. The most important uncontrolled variable was the increasing output of workers as the result of practice. They found that, in the case of some individuals and in certain kinds of work, improvement from practice continued over a period of several years. Two typical curves will illustrate their results which they attribute to the introduction of rest periods. In the first case, a rest pause of ten minutes was

introduced into the middle of the morning's work at labeling. The output records of seventeen girls over a period of twenty weeks without the rest period are available for comparison with the records of the

FIGURE 97

EFFECTS OF INTRODUCTION OF REST UPON PRODUCTION *

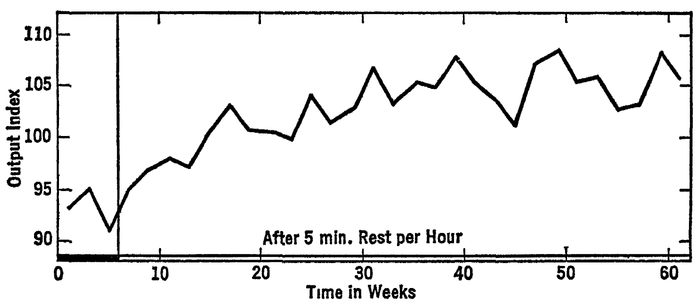


* From H M. Vernon and T Bedford, "The Influence of Rest Pauses on Light Industrial Work," *Industr. Fat Res. Bd Rep*, 1924, No 25, 7.

same individuals over a period of fifteen weeks after the introduction of the rest period. The curve in Figure 97 shows the amount and character of the change. Below the solid line in the figure there is plotted

FIGURE 98

EFFECTS OF INTRODUCTION OF REST UPON PRODUCTION *



* From H M. Vernon and T. Bedford, "The Influence of Rest Pauses on Light Industrial Work," *Industr. Fat. Res. Bd Rep.*, 1924, No 25, 9.

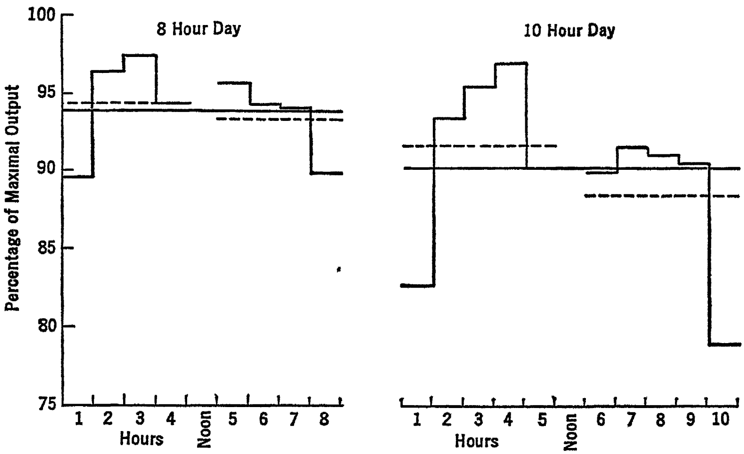
the actual working time per week. A comparison of the two curves will show that the fluctuations in the hours worked per week cannot be responsible for the change in the output beginning at the end of the

twentieth week. Although there was an actual loss of about 2 per cent in working time through the introduction of the rest period, there was an increase in the last six weeks of work of 13 per cent in average hourly output over the pre-rest weeks.

In the second investigation, a five-minute rest was allowed at the end of each hour of work at assembling bicycle chains. This is a task requiring a high degree of attention. The records of seven girls were followed for a period of sixty weeks, and at the end of the first six weeks of this time the rest period was introduced. The change which resulted may be seen in Figure 98. In spite of the loss of 7 per cent of working time on account of the rest periods, the average hourly output increased 13 per cent after the change of schedule.

FIGURE 99

INFLUENCE OF LENGTH OF WORKING DAY *



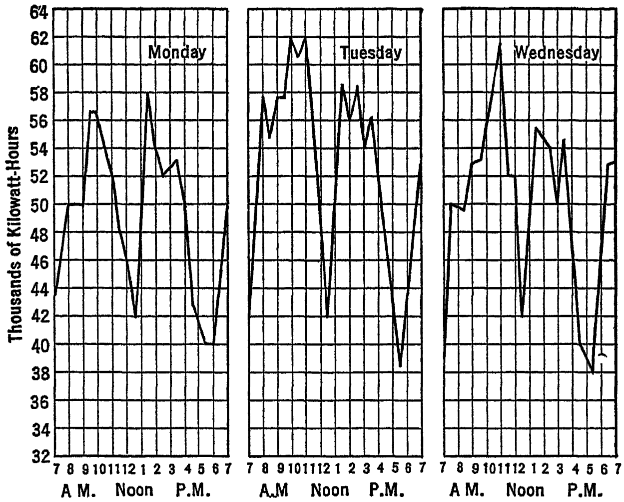
* Adapted from J Goldmark and M D Hopkins, "Comparison of an Eight-Hour Plant and a Ten-Hour Plant," *U S Publ Hlth Serv, Publ Hlth Bull*, 1920, No. 106, 74

INFLUENCE OF LENGTH OF WORKING DAY

The many studies of output in the course of a day's work show two characteristic output curves. They are illustrated in Figures 33 and 34, pages 119 and 120. The one derived from moderately heavy work is convex upward for each half-day, whereas the one derived from rapid, repetitive work, is concave upward. In Figure 99 it is possible to compare two lengths of working day for moderately heavy work. These work curves (*219*) are derived from two manufacturing plants, equivalent in the nature of their work except that the first one worked an eight-hour day and the other a ten-hour day. In each plant

FIGURE 100

WEEKLY OUTPUT CURVE *



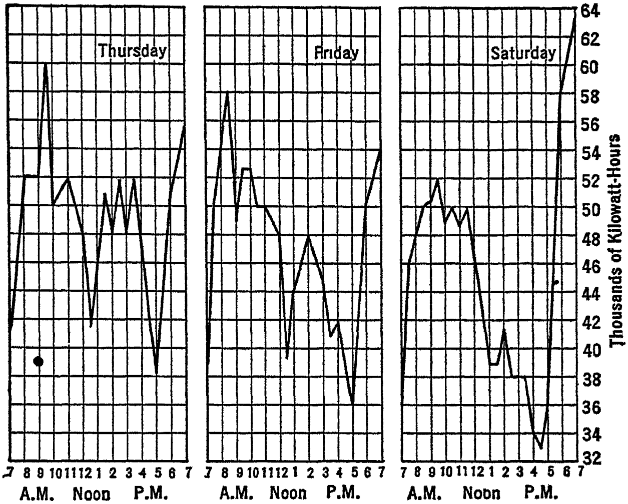
* From W N Polakov, "Making Work Fascinating as the First Step Toward Reduction of Waste," *Mech Eng*, 1921, *43*, 731-732.

all the operations were combined to make the one output curve. The figures are in terms of the percentage of the maximal output of which the plants are capable, as indicated by the scale on the left of the chart. The hours of the day are shown at the bottom of the chart. Both curves show a very low output at the beginning of the day, with the highest output some three or four hours after the beginning of work, with a drop just before the noon hour, and with a still greater drop at the end of the day. The solid line in the chart indicates the average output per day and the dotted line indicates the average output per half-day. The average output for the ten-hour day is 90.3 per cent of the maximum whereas that of the eight-hour day is 94 per cent. The output for the different hours of the day may be read directly from the chart. In every case the average output is higher in the eight-hour day than in the ten-hour day.

The greatest difference between the two work schedules is to be found in the first and the last hour of the day. At least two factors are present here. One of them is the residue of fatigue from the previous day tending to keep down the production, and the other is the definite gauging of output in the light of the length of the task to be performed. These two factors manifest themselves in various ways, such as delay in starting work, a slower rate of work, and more frequent delays. The same two factors are also responsible for the difference in time at which

FIGURE 100—(*Continued*)

WEEKLY OUTPUT CURVE



the maximal score is reached. In the ten-hour day the maximum is reached in the fourth hour of work whereas in the eight-hour day it is reached in the third hour of work.

Such daily output curves have been analyzed by Vernon, who found that, when he divided the first-hour and the last-hour records each into two half-hour periods, the low records were due to delay in starting work and to premature stopping of work rather than to an actual slower rate of work after it had really started. Still, the difference between long and short working days shows itself in a difference of output, and it matters little, practically, whether this result is due to one cause or another, if both are equally the product of the length of the working day. A reduction of working time by two hours does make considerable difference in the shape of the curve, tending to raise all low points nearer to the maximum.

EFFICIENCY DURING THE WEEK

Very much the same picture is obtained when longer than daily work periods are considered. Although data for weekly periods are scarce, they seem to show a mounting efficiency during Monday with a maximal output on Tuesday, followed by a gradual decline in production until the low point is reached on Saturday. The weekly curve of work reported by Polakov (*507*) and reproduced in Figure 100

shows such fluctuations. The data cover a period of fifty-two weeks, so that each day's record on the chart is an average of fifty-two daily records. Output is measured indirectly in terms of thousands of kilowatt hours of electric current consumed in a large number of industrial establishments. The close relationship between power consumed and output for a group of industries was previously established by measuring samples of both and correlating them. Such a measure of output could be employed only where electricity was used primarily for power purposes. The rise of the curve at the end of each day is obviously the result of the sudden use of current for illumination purposes and should be disregarded. There are no curves available to show the possible variations in this weekly curve that would result from changes in work schedules, but there is reason to believe that beneficial changes in the daily schedule would be reflected in the weekly curve. It would be particularly interesting to compare curves for the radically shortened working week of today with those of the earlier and longer week.

ADJUSTMENT TO CHANGE OF WORK SCHEDULE

One of the most significant characteristics of the curves in Figures 97 and 98 is the slowness of the rate of improvement after work and rest schedules have been changed. They look very much like practice curves. In Figure 98 it appears that a period of about twenty-four weeks was required for the output to reach a fairly constant level, which was then maintained for the remaining thirty-two weeks. In explanation of this slow rate of adjustment, the authors (*664,* 11) say:

> The slowness of the adaptation is due to the fact that, as a rule, it is brought about quite unconsciously. The workers get a little less fatigued because of the rests, and in consequence of their increased reserve of energy they gradually quicken up their rate of production until finally they may fatigue themselves as much as they had done previously without the rests.

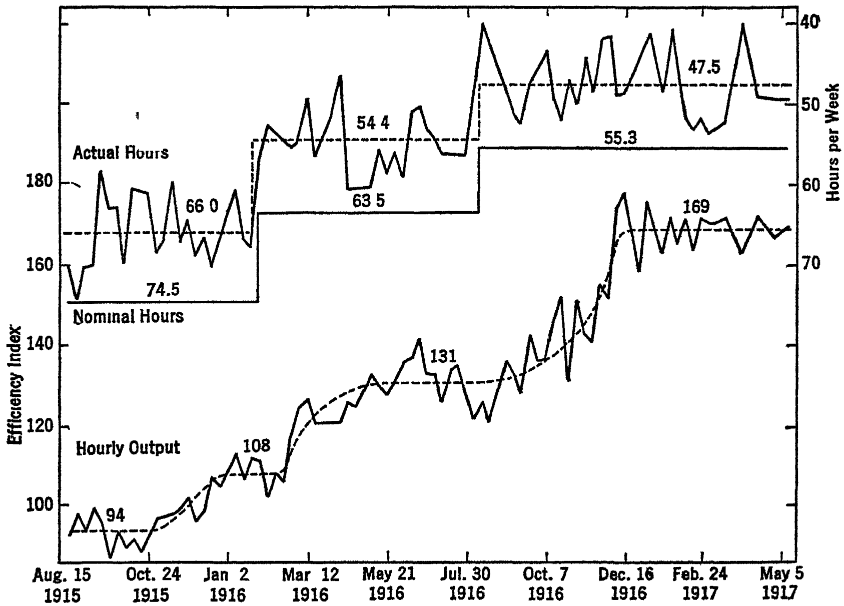
This same phenomenon of slow adjustment is especially well demonstrated in a series of changes of hours of work in one of the war industries in England reported by Vernon (*663*). Output in a moderately heavy lathe operation was followed for a period of ninety-three consecutive weeks (*663,* 9):

> [During this period] there was no alteration whatever in the conditions of production, other than in the hours of work. Fresh workers were not included in the groups until they had acquired a steady output, and as the great majority of the women of each group were included in succeeding groups, it follows that the data may be accepted as giving a fair index of the productive power of experienced workers throughout the statistical period

Figure 101 shows the nominal working hours per week, the actual average number of hours worked, and the "hourly output." In the case of the "actual hours" and "hourly output" curves, both the original curves (solid lines) and the smooth curves (dotted lines) are given. The left-hand scale is in terms of units of work done per hour, and the right-hand scale is in terms of number of hours per week. The curves

FIGURE 101

RATE OF ADAPTION TO CHANGES IN WORK SCHEDULE *



* From H M Vernon, "The Speed of Adaption of Output to Altered Hours of Work," *Industr Fat Res Bd Rep*, 1920, No. 6.

show that a reduction in the number of hours of work per week was followed by a period of adjustment covering many weeks. For instance, following the change from 66.0 to 54.4 actual working hours, there was no change from the output index of 108 for a period of nearly a month. Then there followed a rising curve of output for about two months until the level of 131 was reached. When the actual hours were reduced to 47.5, there was again a stationary period followed by a rise over a period of about three months to a new high level of 169. The increase in output during the first period of 66.0 hours' work per week, from 94 to 108 units of work, is attributed, by the investigators, to recovery from the excessively long hours of actual work put in during the first part of the statistical period. The women averaged 71.2 hours per

week in the first four weeks, but then they appear to have learned by experience. Presumably, in order to maintain their health they took much more time away from the factory and they never averaged again more than 67.6 hours of actual work in any four consecutive weeks.

This process of slow adjustment is the outcome of the tendency to get "set" in a certain pace of work which was so well demonstrated by Morgan (Chapter 7). An individual apparently establishes a "congenial pace" which for him uses in a given work period as much energy as he can recover conveniently, or at least as much as he is willing to spend on the task. When conditions change so as to make more energy available, the old pace hangs on and it takes time to establish the new one which involves a readjustment of mental attitude as well as of muscular reaction.

It is very important that manufacturers should realize the slowness of the adaptation. It is often imagined by them that the improvement comes on immediately, and if, after a trial lasting a fortnight or a month, they find that the output is rather less than before, they are greatly inclined to abolish the change. They ought to allow a three months' trial before coming to a definite decision, and during the trial period no other changes of working conditions should be made. (*664,* 11)

ATTITUDE AS A FACTOR IN ECONOMY OF EFFORT

This discussion of work would not be complete without some reference to the influence of the worker's attitude toward his work. Attention has been forced more and more in recent years upon the significance of personal qualities and social relationships as determinants of adjustment in business and industry. The frequently quoted studies at the Hawthorne Plant of the Western Electric Company (*528*) (*528a*) (*703*) demonstrate that the attitude of the worker had more influence upon his performance than did any other factors such as hours of work, rest periods, and environmental conditions. The fact has been confirmed by other investigators. For instance, a series of studies of mental work by Graf (*227*) (*228*) (*229*) (*230*), has shown that the attitude of the worker towards his work goes through a series of changes *in the course of a single rest period,* such that the willingness to resume work will decrease with the length of the rest. Upon the basis of these findings it should be possible to find the optimal rest interval for a given kind of work so far as willingness to return to it is concerned. Graf showed also that anticipation of a rest period to come will influence the attitude and achievement of the worker in the pre-rest period. The reader may well entertain the suspicion, however, that such attitude patterns may be too highly individualized for purposes

of useful prediction of work schedules. When it is recalled that not only these but all other attitudes are peculiarly personal and arise from a great variety of conditions tangible and intangible, the magnitude of the problem of adjustment will be realized. Among the more tangible conditions to be reckoned with are those that set up a competition for the interest and attention of the individual while he is at work.

24.

Satisfaction as a Goal of Adjustment

Satisfaction has been set forth as one of the goals of human adjustment (Chapter 1), and as one of the factors to be reckoned with in an acceptable concept of efficiency (Chapter 18). Numerous references have been made to it in the discussions of industrial problems, notably those of specialization and standardization and of the cost of work. This orientation in the direction of satisfaction is a reflection of a general social trend in the democracies toward a greater concern for the welfare and satisfaction of the individual. Bowman (*55,* 195) voiced such concern in a plea for a better ordering and preservation of society:

> It must be as important to think about the welfare of the people of the corn belt as to think about the convenience of the self-starter. It must become more praise-worthy to think about the protection of men in a shop than to think about the perfection of the transient and material things which they produce.

An applied psychology which is genuinely concerned with problems of human adjustment should be in the forefront of any critical inquiry into these matters.

THE GOOD LIFE

Satisfaction as conceived in this chapter is commensurate with "The Good Life" as defined by Thorndike in his *Human Nature and the Social Order* (*626,* 403-540), although limitation of space will necessitate focusing attention more narrowly upon the direct and indirect satisfactions from work. Thorndike offers a tentative list of the essentials of the good life. They comprise, in the main, the means of meeting the needs and desires of man that are innate or are at any rate universally present. (These have been discussed in Chapter 2.) He examines the contribution toward the good life that may be expected from the family, the government, the Church, industry, the schools, and from public opinion and from custom.

Thorndike develops from the good life of the individual the conception of the good life of communities and offers a formula for evaluating cities (*633a*) in respect to their support of the good life. The same kind of computation might well be employed for finding to what degree specific industries, businesses, institutions, trades, and professions contribute to the good life of their members. In addition to disclosing differences, such studies could make their most useful contribution in correcting distorted opinions concerning the factors that contribute most genuinely to satisfaction. Relatively uncultivated and unsuspected sources of human satisfaction might thus be disclosed to the administrators of men. The student of applied psychology should read these contributions of Thorndike as a preliminary or as a supplement to the present chapter.

THE NATURE OF SATISFACTION

Satisfaction and dissatisfaction are terms that refer to the way one feels about events, people, and things, or perhaps more frequently just the way one feels. They are descriptive of the feeling or emotional aspect of experience as distinguished introspectively from its intellectual or rational aspect. It is necessary to avoid setting up a sharp dichotomy between these two kinds of experiences, but even those theorists who would reduce them finally to one and the same fundamental process do grant certain important practical distinctions. Most important of these distinctions is the one of sharpness of definition, of localization, or of attachment to a specific stimulus. The feelings are vague and are not localized in a sense organ as are the sensory reactions of seeing and hearing. In fact, the feelings are frequently referred to as "feeling-tones" which decorate and color a perceptual experience, or which float about ready to lend a pleasant or unpleasant quality to whatever reaction occurs. Satisfaction and dissatisfaction fall into this class of events. However complex satisfaction may be in its pattern or in its physiological correlates, it is experienced as a glow of pleasantness or even a *warm* glow of pleasantness. Dissatisfaction cannot be so readily characterized but it will be recognized as unpleasant.

If the preceding modest generalizations are acceptable, adequate justification is at hand for attaching great significance to satisfaction-dissatisfaction in adjustment. A glow of satisfaction pervades the day's work and makes events seem to run smoothly, or a cloud of dissatisfaction descends and envelops the worker in a fog of discontent. When one is satisfied, he is satisfied "all over," and when he is dissatisfied, he is dissatisfied "all over." Many a business man's day can be spoiled because of a mislaid morning newspaper or a broken shoe lace, and

many an industrial worker's day can be made a failure through jealousy, a headache, a family quarrel, or a sick child, as readily as it can by an overbearing boss, a monotonous kind of work, or a poorly adjusted work bench. It would seem, therefore, that efficiency would demand surveillance of the twenty-four hours of each day, once named by a neurologist the "biological work day." This label implies that the accomplishments of a worker during his eight hours of work depend upon his use of the remaining sixteen hours, as well as upon the characteristics of his eight-hour schedule. The quality and quantity of his food, the number of hours of sleep, the character of the recreation that he chooses, and the people with whom he associates, all these and many other influences will be reflected in his day's work. As Hartman and Newcomb (*247*, 112) have aptly pointed out:

> It makes little difference in the last analysis whether a man comes to hate his boss or his job because of some highly personal difficulty such as insomnia or because of a generalized notion that he is being made the victim of an unjust economic system. The transference of the animus, the fastening of responsibility upon some convenient tangible object, is the thing that makes for conflict.

COMMON CAUSES OF DISSATISFACTION

It is a matter of common knowledge that the most trifling occurrences may cause annoyance, but any one may well be appalled to see a catalogue of them and to realize how many of them he himself may unwittingly be responsible for. Cason (*92*) has prepared such a catalogue and has drawn a number of interesting implications from a systematic study of it. He obtained from 659 people, representative of all walks of life, a list of the everyday occurrences that commonly annoy them. Including duplications, 21,000 were reported to him. Of these, 57.4 per cent had to do with human behavior, nearly four times as many as the next largest group. Non-human things and activities exclusive of clothes accounted for 15.6 per cent, clothes and manner of dress 12.5 per cent, alterable physical characteristics of people 9.8 per cent, and persisting physical characteristics of people 4.7 per cent. Thus, it appears that of all common annoyances 79.7 per cent are caused by people, their manner of dress, and their physical characteristics that could be changed. Only about one-fifth of the annoyances, therefore, would seem to be relatively unavoidable.

The following list of occurrences chosen more or less at random from Cason's list are such as might easily and frequently be found in the work situation, causing annoyance either toward a superior, or toward a fellow worker: affected behavior, gushing behavior, excessively polite behavior, loss of temper, habitual arguing, attracting attention to oneself, very loud laughter, very loud talking, persistent gum chew-

ing, blowing the nose loudly, clearing throat, coughing or sneezing without covering nose. A still more potent group would seem to be: telling one to do something when he is about to do it anyway, giving advice when it is not requested, ordering one around, telling one to hurry, speaking in a dictatorial manner, nagging some one. Any person, regardless of whether he be employer or employee, could profit from a serious reading of Cason's list with a view to modifying his behavior where it would make for greater satisfaction in relation to other people.

One might legitimately inquire whether there are not a relatively few fundamental annoyances that manifest themselves in the many hundreds of specific reactions such as Cason's study disclosed. Carter, Conrad, and Jones (*90*) applied the factor analysis technique to the search for such primary factors in children's annoyances, with suggestive results. There was an indication of four factors, three of which were fairly stable. Even if there turned out to be as many as ten fundamental human irritants of this sort, the mere recognition of them would be an important step in the direction of their elimination.

EFFECTS OF MOOD UPON PERFORMANCE

It has been pointed out frequently heretofore that satisfaction is desirable in itself and that it should be one of the products of work to which every worker is entitled. It has been the expectation, nevertheless, of those concerned with increasing efficiency that decreasing dissatisfaction, and thereby raising the general level of satisfaction, would improve performance. Even contented cows can be counted on to produce better milk, if one can trust advertising slogans. Definite evidence supporting such superficial impressions is difficult to obtain. When tests are made under laboratory conditions, the direction and strength of the feeling tone are hard to guarantee. Such experiments as have been reported are at least suggestive in the direction of the expectation.

Many experiments a decade or more ago (*424*) (*577*) were set up to find whether forgetting was the more active for experiences which were in themselves pleasant or for those which were unpleasant. Most of these studies were obviously inspired by the Freudian doctrine of suppression. Even with the highly attractive theory inviting support, the results were in the main equivocal and at best merely suggestive of the greater tendency for the unpleasant to be forgotten.

These studies are not, however, directly pertinent to our present inquiry. More directly to the point are those that seek the effects of a state of feeling upon experiences which occur in that state. Crawford (*120*) created a pleasant or unpleasant mood in young children by

reading pleasing or depressing stories to them, and followed each by exercises in the learning of simple materials. Although her results were not statistically reliable, she found differences favoring the pleasant mood. Sullivan (*599*), using three groups of subjects and testing them separately, depended upon the spontaneous fluctuations of mood with which to correlate performance on a variety of laboratory tests. One of her groups consisted of ten patients who had presumably recovered from manic-depressive insanity but who had not yet been discharged from an institution. In these cases she hoped to find more frequent and more exaggerated fluctuations in mood. The other subjects were college students. She employed a large variety of psychological and physiological tests. Although the relationship between mood and performance, when expressed in terms of coefficients of correlation, was just about zero, she nevertheless felt that there was a real positive relationship, hidden by the tendency of her subjects to compensate for feeling low by the expenditure of extra effort.

Roberts (*520*) created moods of elation, depression, and normality in four subjects by means of hypnotism whereby he suggested the mood for the post-hypnotic state. Each subject was tested for speed and accuracy of card sorting in each of the three states. Three of his subjects were considerably slowed during the depressed state, while all four were speeded up but only very slightly in the elated state. Roberts was impressed with the likelihood of individual differences affecting his results and advocated the repetition of his work on a more extensive scale.

CONDITIONS LEADING TO SATISFACTION IN WORK

The reader need not be too much concerned about the relatively sterile outcome of the laboratory studies just reviewed. He may choose to rely upon the positive findings of the case-study method and the clinical method, or he may look forward to the development of more adequate laboratory techniques. Meanwhile he should recall that satisfaction from work is an end in itself and that it needs no justification in improved performance.

Two distinct and conflicting programs have been offered for insuring satisfaction from work. The first aims to make the work itself interesting. Innumerable devices have been adopted for this purpose, such as incentives, wage schemes, comfort accessories, beautiful surroundings, opportunities for social intercourse while at work, music, part ownership of the industry, and many others. The second assumes that work as such is inherently unpleasant and always will be so, that the present trend of industry cannot be greatly interfered with, and that frank

recognition of the fact is essential. According to this point of view, working hours will be made as short as possible and the returns for work as remunerative as possible. Effort will then be concentrated on creating satisfaction in the non-working hours.

The well-known efficiency system of Gilbreth puts emphasis upon the first of these points of view; the industrial philosophy of Henry Ford offers the best example of the second. Both types of system recognize the need for manifestation by the individual of his native impulses, his motives and aspirations for self-expression, for ownership, and for recognition in the eyes of his fellows. The former would accomplish these ends by allowing scope for originality and inventiveness in the worker by giving him credit for useful suggestions and innovations in connection with his tasks, by arousing competition, rivalry, pride in the quality and quantity of his work, and by making him realize the useful service rendered by the articles that he helps to make. The latter would accomplish the same end by disregarding all aspects of industrial work except those that are conducive to high output. High wages and short hours of work would give time and facilities in the leisure hours for the expression of personality.

One need not take sides in this important issue at the moment. It is sufficient to recall that the very nature of satisfaction and dissatisfaction is such as to lead to the spread of their influence over the twenty-four hours of the day, no matter how these hours happen to be spent. It will be our first task to discover the conditions of *satisfaction in the work situation,* and our second task to inquire into those satisfactions that originate elsewhere but *carry their influence into the work situation.*

SATISFACTION FROM PROPER WORKING CONDITIONS

It has already been noted in our discussions of specialized and standardized work programs (Chapters 20 and 21) that such work conditions may affect the degree of satisfaction from work. When employees are given an opportunity to say what makes jobs satisfying or dissatisfying, they rate high the factor of variety in what they are called upon to do. Also they value the freedom to choose the way in which they shall do any specific thing. It is found too that rest periods introduced at appropriate intervals give satisfaction not so much for the relief of fatigue but for the mere fact of change. Elimination of rest periods or reduction in their length are frequently resented because the sum total of satisfaction is thereby reduced. One can speak concerning this matter only in rather general terms since individuals differ in respect to what gives them satisfaction as in every other respect. But over and

above these differences among individuals there is a sensitivity to the many work variables that contributes to the general undercurrent of feeling, whether it be predominantly satisfying or dissatisfying (*528*).

SATISFACTION THROUGH ADJUSTMENT OF CAPACITY

The greatest hope of satisfaction from work lies in putting each person into the type of occupation for which he is best fitted. There must be the proper interrelation of the strength of the worker and the strength required of him. The same is true of physical endurance, intellectual capacity, and all other significant traits. Individuals differ in these respects and it is a vital matter to recognize the importance of such differences. The fear has frequently been expressed that, when such adjustments have been made, there will be no one to do the menial tasks. With the introduction of machines to take over more and more of the heavy and routine work, there will, doubtless, be enough persons who will get satisfaction from doing the remaining menial tasks. The study of the interests of people of low mentality and of opportunities for employing them in industry has demonstrated that there are many who prefer routine, repetitive, and menial activities and who shrink from tasks that are more complex and responsible. Such persons have been found to make excellent and satisfied general handy men, hotel dishwashers, window cleaners, assistants to masons and carpenters, laborers, errand boys, cobblers, bootblacks, and chair caners.

Data were presented in Chapter 15 to show the close relationship between intellectual capacity and satisfaction from work in cases where satisfaction was measured through direct inquiry and where it was inferred from labor turnover. Certain jobs were enjoyed most by relatively low-grade mentalities and others by relatively high mentalities. Burnett (*65*) has shown in a laboratory experiment upon simple repetitive tasks arranged to resemble factory work, that the more intelligent workers disliked the work and found it very tiresome. They made poor production records, although in spurts they proved that they had the capacity to make much higher records. The best record was made by a person of average intelligence who enjoyed the work and consistently did her best. The least intelligent one of the group, although not making such a good record as the others, kept up a steady output and expressed satisfaction with the job. Thus it appears that monotony, which is a matter of the interrelation of the worker and his work rather than a characteristic of the work itself, can be largely reduced by the proper placement of individuals according to their capacity. In other cases, although it may never be eliminated

entirely, much can be done to reduce monotony by the introduction of frequent rest periods and the shifting of occupation.

Many valuable data could be gleaned from the case histories accumulated by those personnel officers who have a real concern for the proper adjustment of the individual worker. Unfortunately, such material is confidential and seldom becomes available for publication. Anderson (*12*) (*13*) has, however, made available in print a series of cases studied by him. In some of these, personality problems arose because a higher grade of performance was expected of the worker than he could produce. The cases in which capacity was greater than was required eliminated themselves. Careful examination of the employee followed by a shift to a more appropriate occupation led in most instances to an efficient and happy adjustment. There was the case of a girl cashier with an IQ of 88. She was slow in speed tests, poor in motor dexterity, and had a low record in accuracy tests. In fact, she was deficient in the very qualities which the job of cashier required in high degree. It is not surprising that, since she needed her job badly, she gave evidence of an emotional upset with depression, inability to concentrate on her work, and a definite tendency to mental reverie.

As she had a rather good appearance, was neat and attractive, and had on the whole a pleasant and agreeable personality, she was transferred to the house furnishings department as sales clerk. She was successful in selling, enjoyed her work, was promoted and, at the time the report was made, was being considered for promotion to stock head, "a promotion for which there is considerable competition." Although a certain amount of credit might be claimed for psychiatric therapy in this case, the main factor was proper adjustment of capacity to job.

SATISFACTION THROUGH ADJUSTMENT OF PERSONALITY

Every one of the current classifications and descriptions of personality suggests differences among people of a kind which a practical vocational counselor would need to recognize in advising them. Introverts and extroverts, ascendants and submissives, motor and mental, mechanical and social adjust differently to life situations. The very early classification prepared by Schneider (*540*) had some merit when intelligently employed. It assumed that some persons were inclined toward mental work and others toward manual work; some liked a settled life and others a roving life; some enjoyed indoor work and others outdoor work; some preferred projects of large scope and others of small scope; some were deliberate and others were impulsive; some tended to concentrate their energy whereas others tended to diffuse theirs.

The careful interviewing of a candidate in the light of such categories could well lead a keen observer to a successful vocational "insight."

Such vocational methods fall below the ideal testing technique but they do resemble the case-study method and the clinical method which are not without their proponents. There is no intention of reopening the discussion of testing methods, but merely of pointing out the probable significance of such slippery personal traits for satisfactory adjustment. The detailed work histories of a few industrial workers by Whitehead (*703*), although not amenable to brief description, have demonstrated that personal qualities together with the attitudes that developed out of them are of the utmost importance in work satisfaction. Hall (*237*) has predicted that it will be entirely possible to find persons who will get satisfaction from doing the disagreeable jobs of life such as the handling of garbage, the marking of soiled laundry, the cleaning of sewers. To these same persons the job of forest ranger or cowboy might seem intolerable.

Anderson (*12*) described the case of a sales clerk who was referred to him because she was depressed, nervous, getting thinner every day, tardy, and inefficient. Her physical examination was generally negative. She had an IQ of 102, with a good record in speed, accuracy, dexterity, and learning tests. She was coöperative and responsive, but oversensitive about herself and self-centered. She was not aggressive and did not make effective contacts in her work with customers. There was a tendency toward pessimistic reverie and she was not alive on her job. She was an introverted type, better suited to clerical work than sales. The girl was transferred to a clerical office job where her health improved, she gained in weight, and "she did her job splendidly. The girl herself likes her work very much and her adjustment seems satisfactory."

SATISFACTION FROM SOCIAL INTERCOURSE

Work may create satisfaction through the opportunity for social intercourse. To be one of a group and on terms of good fellowship with its members is a source of great satisfaction. Gilbreth made a special effort to organize congenial groups by selecting their members according to race, creed, and politics. Membership in a group with common interests and purposes constitutes a strong attraction of lodges, clubs, and secret societies. The working environment frequently affords the best opportunity for associating with congenial people. More use could be made of these facts in industry. In the experiment of Burnett referred to on page 442, the workers sat around a table. On certain days talking was prohibited. Although on such days the production did not decline, all but one of the group hated them. The one who did not object to the

silence had the lowest grade of intelligence and felt that the talking interfered too much with her work.

Whitehead (*703,* Chap. 27), in his discussion of the industrial worker, attaches great importance to the worker group as a social system in which each member contributes something to the activity and variety of the group, and the group enjoys "the immediate social satisfactions of doing things together." He emphasizes the satisfaction that comes from doing purposeful things together in contrast to purposeless activities, such as dancing.

Along with this satisfaction from social intercourse goes an added pleasure when an individual attains some importance or distinction in his group, or at least holds its respect. It is a real torture to become an outcast or a "scab" in relation to one's class, for his standing in the world is determined by his standing in his social class (*312*). A butcher is content if he is known as a good butcher—it is no degradation to him to realize that he is not a good surgeon. Let his ability as a butcher be questioned and the reaction is an entirely different one. Likewise, the plumber gets his social status among plumbers and does not have to compete with dentists or tool makers. Even the lowest and most menial jobs in this sense give a chance for a feeling of importance and its accompanying satisfaction. It is said that thieves and robbers have their own codes of behavior, and one who attains distinction among them is not disturbed at the status of his occupation elsewhere. The misery of an occupant in the death-house of a prison may be much increased by the disdain of his neighbors.

SATISFACTION AND HAZARD

Few data are available on the question of the relation between dissatisfaction and the hazard of the work. There is good reason to expect, however, that those occupations that are most satisfying would in general be the ones where the hazards are the slightest. There are two reasons why this might be difficult to demonstrate. First, there is at least a partial compensation for extra hazard in the way of increased remuneration so that dissatisfaction might be suppressed. Second, there are some persons who seem to enjoy a large element of risk, as in driving racing cars, flying, and exploring, but the number of such persons is relatively small. It has been suggested that if occupations were arranged in the order of their hazard and in the order of their dissatisfaction as measured in agitations, strikes, and so forth, the relationship between the two arrangements would be close. Another way to demonstrate a causal relationship would be to note changes in the hazard of industries and the changes in satisfaction of the workers over long

periods of time. The problem would be complicated, of course, by the presence of other changes along with changes of hazard. An interesting table of such hazards and their changes over a period of twenty years has been computed for a series of English industries (*108*). These are reproduced in Table 55. The hazard of each occupation is expressed as a ratio of the hazard of the ministry, which has the lowest hazard and is given a rating of 100. The derivation of the hazard index is

TABLE 55

HAZARDS OF INDUSTRIAL WORKERS *

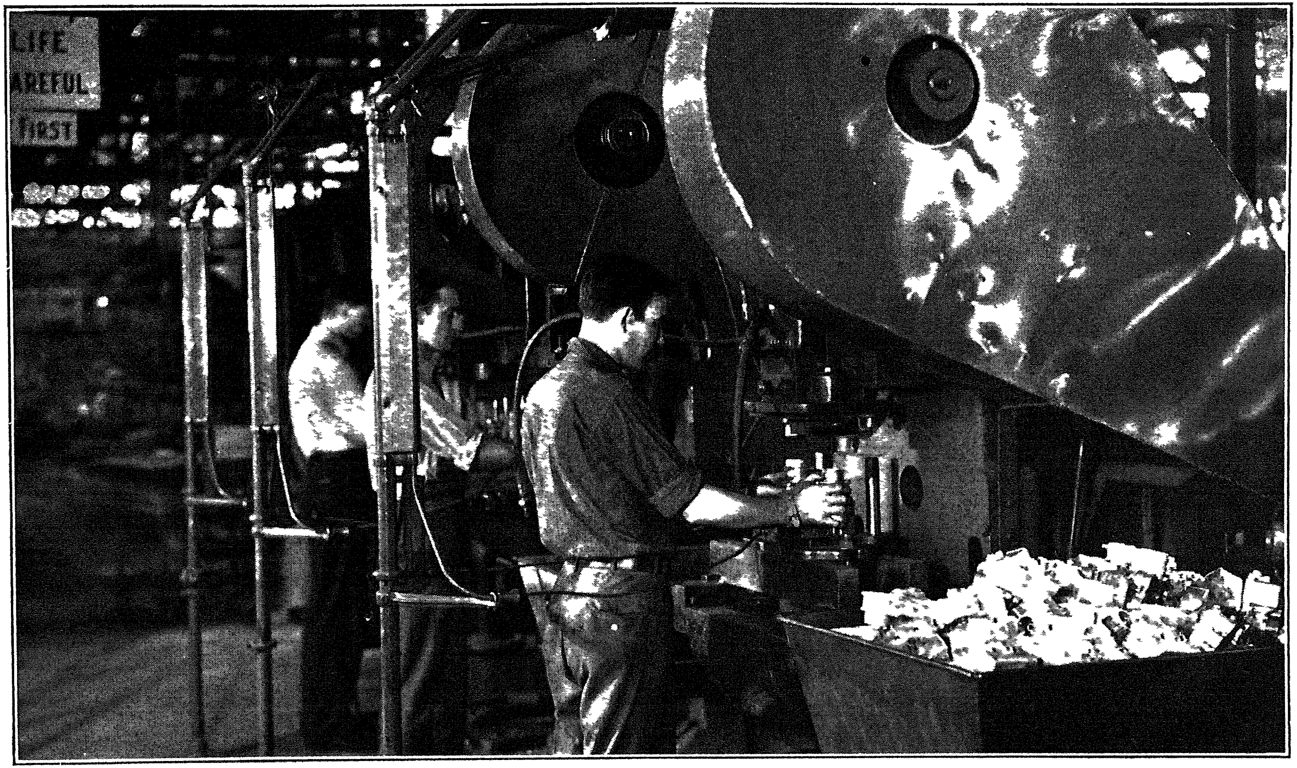
	1890	*1910*
Clergy	100	100
Agricultural laborers	119	106
Commercial clerks	172	181
Coal miners	174	164
Bricklayers	188	149
Saddlers and harness-makers	174	166
Cotton manufacturers	214	183
Wool and worsted manufacturers	186	151
Silk manufacturers	173	162
Hosiery manufacturers	131	166
Lace manufacturers	133	174
Carpet manufacturers	164	145
Tinplate workers	187	152
Chemical workers	262	147
Paper makers	170	153
Shoemakers	173	188
Tailors	186	180
Cabinet-makers	184	179
Printers	206	174
Bookbinders	199	179

* Adapted from E L Collis and M. Greenwood, *The Health of the Industrial Worker* (Philadelphia, Blakiston, 1921), p 73.

complicated and need not be described. Some industries have risks more than two and a half times as great as others. The amount of change in some industries over a period of twenty years, as in the case of bricklayers and printers, shows that great improvements are possible. No figures for satisfaction in these industries are available.

Figure 102 furnishes a perfect illustration of the hazards of modern industrial processes and the need for protecting the worker against accident and the fear of accident. In this operation the workers are shielded from the consequences of a false and improperly timed motion. The cuffs on their wrists are so connected to the machinery that in case of error their hands will be jerked out of danger. It would be interesting psychologically to inquire into the mental state of one who must depend for safety upon such an automatic device.

Guarding Against the Hazards of an Industrial Process *



* Furnished through the courtesy of B. A. Grainger, Safety Engineer, Bendix Products Division of the Bendix Aviation Corporation, South Bend, Indiana

SATISFACTION AND SECURITY

Within the term hazard should be included the uncertainty of employment. There are many aspects of this problem that are economic rather than psychological, but fear of losing one's job, worry for the welfare of a family, and the demoralization of idleness are mental states that play their part in unrest. The introduction of modern industrial methods seems unquestionably to have increased the hazards of unemployment. Extreme specialization and standardization of functions have shortened training periods. When a job can be learned in a few hours or days, replacement of workers is not the serious matter it was when a long apprenticeship was necessary. Moreover, the rapid tempo of modern industry tends to disqualify workers at an earlier age. Added to these facts is the disruptive effect of technological changes which throw whole groups of specialists out of employment. The insecurity thus inevitably aroused is being met by such devices as old-age insurance and unemployment insurance.

A more satisfying type of remedy for the sense of job insecurity is the search for family relationships among jobs, so that those who are out of employment for whatever cause may discover those available jobs for which they are already fitted or for which a minimum of additional training will be required (Chapter 12). The evils of seasonal work are generally recognized and the attempts to cure them are meeting with success. In the building trades, for example, the arousal of interest in the possibilities of all-year work and the invention of methods and materials that make such work possible have done much to create steady employment. The widely advertised sales of overcoats in August give summer employment to a group of seasonal needleworkers who might otherwise be idle. The opportunities for the same type of improvement are just as great or greater in other industries. A full recognition of the psychological advantages to be gained, along with the economic advantages that are already thoroughly understood, may help to initiate the necessary changes.

The fear of unemployment aroused by the arbitrary exercise of discharge on the part of foremen who do not hold the respect and confidence of the worker can be entirely eliminated by the installation of proper personnel methods.

SATISFACTION FROM SELF-EXPRESSION

The discussion of satisfaction in work may conclude with a few observations upon the need for self-expression, and the dissatisfaction which comes from thwarting it. This was a popular theme two decades

ago, and innumerable books and articles (*103*) (*483*) (*605*) (*647*) (*658*) were written to prove the stultifying effects of modern industry. The psychologists' list of instincts played directly into the hands of industrial reformers, while the Freudian psychology appeared to give ample proof of the damage to be expected from their repression. It was then that all personnel problems of industry and business were in the way of being solved by psychiatric techniques! (*572a*) (*572b*) (*572c*).

Preceding chapters of this book have furnished ample though scattered evidence that there are impelling motives in human behavior, whether they be named instincts or attitudes and whether they are conceived to be native or acquired through education and experience. There is evidence, likewise, of the warping effects of frustration (*142*) upon the personality. But in applying such findings to industrial situations it must be recalled that nature does not prescribe just the way in which native urges shall be satisfied. If there is a curiosity drive in human nature it is satisfied in a great variety of ways by different people. For one person it may be appeased by developing a mathematical formula or by searching the heavens for a new star, for another, by prying into a neighbor's private affairs or by solving a cross-word puzzle. Education is a potent factor in determining what the means of satisfaction shall be, although limits are set for each individual according to his "stature."

As Thorndike (*632*) has pointed out, it is natural for every human being to be active both in body and mind. Such activity gives satisfaction as long as the particular character of it is within the capacity of the individual as to quality, quantity, and duration, and does not impose undue strain upon him. Furthermore, there is nothing in nature which demands that such activity shall be useless rather than productive. In fact, it appears that, other things being equal, useful activity gives more satisfaction than useless. The notion that all productive activity is distasteful is contradicted by the fact that many persons choose for recreation that which is the work of others. Automobile driving, gardening, chopping wood, even the digging of ditches, serve both for recreation and for jobs. Added to this is the well-known fact that many persons continue their work from the sheer pleasure of it long after there is any need for the financial return that it brings. Then too, one does not always choose a recreation that differs from his work. Many a chauffeur on his Sunday off will spend the whole day driving a car. The writer knows of a cook who frequently spent her weekly half holiday preparing a big dinner for her friends.

The striking characteristic of recreation as contrasted with work is that it is adjusted in quality, quantity, and duration according to capacity and in addition gives a sense of achievement and purposeful-

persons regard it as desirable, other things being equal, to change nature so that it will satisfy more "good" wants of more human beings. So they plough land, sow crops, bridge streams, destroy disease germs They also regard it as desirable to modify the wants themselves, strengthening the "good" ones, such as the cravings for justice, truth, or beauty, and weakening or exterminating the "bad" ones. (*626*, 96)

What are the great educational forces through which our everyday wants are built up? One of the most effective of the causal forces, if not the most effective, is imitation, the desire to conform, showing itself in the striving to become more like our betters. This is the soul of fashion and causes a continual shifting of our specific purposes. A certain individual finds that his neighbor has purchased a bicycle, and soon he too must have one; then the neighbor buys a Ford car, and again he must have a Ford. The neighbor buys a Buick and the Ford no longer satisfies. So it is with a thousand items of daily life. Emulation continues and the burden of cost rises. The matter would not be so serious if the neighbors were equal in resources as well as in wants. But with the growth of easy means of communication—newspapers, magazines, motion pictures, advertisements, automobiles—all men are in one sense neighbors and know well each other's manner of life. Emulation is restricted not alone to those with like resources, but spreads from class to class. For the obvious and superficial "goods" of life, the laborer may have the same desires as the manager, the executive, and the owner. The story is told of a Negro laborer, who, upon receiving very high wages during the first World War, crowded two player pianos into his three-room home and bought oriental rugs so large that they had to be rolled up at one end in order to be used in the rooms. But individuals cannot carry out such purposes indefinitely.

When such cultivated desires are interfered with, resentment and anger are likely to result. Deprive a dog of his bone when he is hungry, hold an infant's arms when it wants to move, and in either case angry responses will follow and will continue until the purpose can be carried out. Pedestrians often feel resentment when others impede their progress along the street, if only for a moment. Adult life is full of such resentments which are seldom clearly identified with or attributed to their proper causes. Moreover, these feelings of dissatisfaction and resentment accumulate and color the whole life of the individual for the time, and may in some cases be surprisingly long-lived.

POWER AND DESIRE

A serious social problem takes its origin from the fact that the desires of people are very similar whereas there are wide discrepancies

in the power to satisfy them. Similarity in wants, difference in power, lead to dissatisfaction. Power for accomplishment—call it intelligence, although it is probably much more than that—is a natural endowment just as fundamental wants are, but it is not uniformly distributed as wants seem to be. There can be scarcely any doubt today that this is so. The following, quoted from John Dewey (*134*), a severe critic of modern intelligence measurement, recognizes such differences in power:

> The most ardent of the early advocates of equality never fell into the stupidity of alleging that all persons are quantitatively alike. Rousseau was one of the first to insist upon natural differences, psychological and physical. It was his profound conviction of the intensity and scope of these differences which made him so insistent upon political, legal and, within certain limits, economic equality. Otherwise, some form of native superior energy would result in the enslavement of the masses, adding artificial enfeeblement to their natural deficiencies, while corrupting those of superior ability by giving them an artificial mastery of others and a cruel contemptuous disregard for their welfare.

It would seem that raising the general level of living will not solve the present difficulty because *satisfaction is a relative and not an absolute quantity.* One's bread and cheese is likely to turn sour in the mouth at the sight of another's cake and champagne. As the general level of living shifts, the purposes and ambitions shift along with it, while power does not thus shift. Indeed, it would appear that the higher the level of living rises the greater will be the unrest, for the greater will be the disparity between the Haves and the Have-nots (in terms of intellectual power) unless increasing disparity is inhibited through artificial means. There scarcely seems to be the increase in satisfaction of the worker that might have been expected from the elevation of the standard of living during the last fifty to seventy-five years.

CONCEPTIONS OF HUMAN VALUES

The whole problem thus far discussed depends on the fact that our conception of human values rests upon power and not upon motives and purposes, upon ability rather than upon intentions. Hence greater importance is attached to differences in the former than to likenesses in the latter. Moreover, power is interpreted to mean economic power, that is, power which is manifested in the production of what is economically valuable. The executive head of an organization is of more value than one of its ordinary laborers, because he produces more, therefore he gets a greater return for his services. His standard of living is correspondingly higher. A notion of the discrepancy in value, thus measured, may be gained from the fact that a company may insure the life of its head for a million or two million dollars, but

takes out no life insurance on its laborers. And yet, if values were calculated on the basis of motives and purposes, instead of capacity to produce, these individuals might be equal.

It seems from the foregoing analysis of the fundamental human factors in satisfaction that the recognition, on the part of any one or all parties concerned, of common purposes will not bring the degree of coöperation that we might wish. For there will still remain the disparity of economic power (depending on intellectual power among other factors) with the consequent disparity in value and return for services. Can or should the standard of values be shifted from its economic to a purpose basis, so that all whose intentions are noble and who prosecute them to the best of their capacity will be equal in value and be equally rewarded? This is a problem for the social philosopher rather than for the psychologist. Such a proposal is implied in the idea of "moral values" according to which every one shall be rewarded according to the degree to which he fulfils his mission in life, whatever that mission may be. He who has ten talents and makes the most of them shall receive no more than he who has one talent and makes the most of that. To quote again from Dewey (*134*):

> Our new feudalism of the industrial life which ranks from the great financier through the captains of industry down to the unskilled laborer, revives and reenforces the feudal disposition to ignore individual capacity displayed in free or individual pursuits. Sometimes in theory we conceive of every form of useful activity as on a level with every other as long as it really marks the performance of needed service. In these moments we also recognize in idea at least that there are an infinite number of forms of significant action. But these ideas are usually restricted to religiously accented moments When it comes to practical matters, the very person who in his religious moods asserts the uniqueness of individuality and of opportunity for service falls back upon a restricted number of conventionally formulated and esteemed occupations and is content to grade persons in a quantitative comparative scale.

This chapter has shown that the satisfaction of the worker is a highly complicated matter and that dissatisfaction is not to be cured by a single remedy applied either to the working or non-working conditions. Our feelings are products of all our activities regardless of their sources, and they diffuse into a total state called satisfaction or dissatisfaction. The origin of the components of this state is difficult to trace. The greatest and most immediate benefit will come from the proper selection of individuals for their work according to their intelligence and character fitness, and from their proper adjustment to their working conditions, so as to remove the obvious causes of irritation and so as to safeguard their health and life. The dissatisfaction arising from the unequal distribution of the world's satisfiers presents

a more serious problem for which no practical remedy has yet been offered. The greatest hope of a remedy lies in the thorough understanding of human nature, the manner in which and degree to which it may be safely modified through the forces of education and social pressure. Such an understanding should pave the way for a readjustment of the work and the worker to each other so that he shall get satisfaction in return for a full exercise of his capacities.

THE MEASUREMENT OF SATISFACTION

After this comprehensive survey of the factors that lead to satisfaction and of the effects of satisfaction or dissatisfaction upon human behavior, there remains one final and important question: Can satisfaction and dissatisfaction be measured? If it is important to know of its presence or absence, it may be equally important to measure the degrees of its presence. Such measurements as have been made have been few and crude. In general, industrial research has been content to say that a given condition is or is not satisfying. Still it is feasible to do more than that. All that was said in Chapter 13 about measuring human characteristics "in terms of more or less" holds equally well for degrees of satisfaction. The techniques described in Chapter 14 for the construction and use of rating schemes are adaptable to the measurement of satisfaction. Special forms of rating technique have been devised for the rating of attitudes of all sorts (*379*) (*448*) (*643*) (*626,* Chap. 7). Cason (*92*), in his cataloguing of common annoyances described on page 438, had them rated for their degree of annoyingness. Uhrbrock (*654*), too, has demonstrated the feasibility of measuring the attitudes of satisfaction and dissatisfaction in work by devising a special rating scale and with it evaluating the attitudes of the employees of a large industrial organization.

The obstruction methods used in the study of animal motivation are suggestive for the measurement of human satisfactions. The various animal drives have been rated by determining the amount of punishment an animal will undergo to satisfy them or the number of times it will endure a given punishment to satisfy them. In an analogous fashion Thorndike (*626,* Chap. 7) has suggested that human satisfaction and dissatisfaction may be assigned quantitative values in terms of the money that one will spend to attain the former and to avoid the latter. Satisfaction in money units could then, according to Thorndike, be counted, added, subtracted, or submitted to any quantitative arithmetical treatment. Thus, says Thorndike, if a person will pay a dollar for a certain book, concert, or pair of shoes, and two dollars for a hundred cigarettes or a hat, he may have wanted the first three equally much

and the cigarettes twice as much as these. And the satisfaction from possession of the hat may be said to equal that derived from two cigarettes per week for a year.

The perfection of attitude-measuring devices to the point where they have practical utility will open the way for further attempts to develop, control, and modify attitudes, for the effectiveness of any means of changing attitudes can only be determined when there is some way of measuring the changes which the means bring about. Although there has been no systematic effort to create changes in satisfaction, other attitudes have been thus attacked and some progress has been achieved in estimating the relative potency of various means to this end (*349*)

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Psychological Problems in the Distribution of Goods

The adoption of the psychological attitude toward the problems of marketing is producing changes as profound as those which resulted from its introduction into industry, where the process of adjusting the work to the individual is still in progress. A casual survey of the hundreds of older books and articles on the problems of the distribution of merchandise, as far as it concerns contact with the consumer, reveals an interesting point of view. The process of transferring goods from seller to buyer was conceived as a kind of combat in which all plans must be laid so as to guarantee that the distributor shall win and the consumer shall succumb. The terms used clearly indicate that this is the attitude in which the consumer was approached. There was talk of the "strategy" and the "tactics" of salesmanship, of the "sales attack," of the "shotgun method" and the "rifle method" of selling, of the technique of "breaking down resistance" and of "consumer defenses." Goods were manufactured and *had* to be disposed of. Somebody must be made to buy them.

In striking contrast to this militaristic point of view is the modern psychological conception of the consumer as an entity with certain wants and desires, of the distribution of goods to the consumer as a rendering of service to him, as a means of providing him with what he wants and of giving him satisfaction. This is not a mere change of terminology but represents a radical shift of attitude toward the whole problem of marketing. To be sure, in practice there may be a mere superficial shift in terminology without a shift of technique. Such is the state of affairs in most of the current usage of the term *service*. On the other hand, the actual attitude of service may be made the keynote of the marketing program, although the older combative terminology is retained. A careful examination is required to determine the true nature of any particular conception underlying methods of distribution.

The proper conception of the problem of distribution as one of service implies a knowledge of what people really need and want and a knowledge of the means of satisfying these needs and wants. It is the particular function of psychology to build up such a knowledge of human nature as this conception requires. The everyday association of one individual with another is not at all likely to furnish this basic information, for human motives and desires are often disguised, and even to oneself they seldom appear in their true form. This is demonstrated in the reasons that persons give for their actions.

It frequently happens that, where the ideal of service is behind a selling plan, failure will occur because there may be an inadequate or distorted knowledge of the people that are to be served. A keen appreciation of the problems of distribution in terms of human nature should lead the inquirer to seek the aid of observers trained in the psychological laboratory.

PURCHASING POWER OF THE CONSUMER

The marketing of goods requires a knowledge of all the characteristics of human behavior and the way in which these characteristics are distributed within the population as well as the conditions upon which the expression of these characteristics depends. Such a program involves the whole content of psychology and economics, although certain parts of these fields have a more direct application than others. The facts of psychology that are most important are those that concern the "desire to purchase," while the facts of economics that are most important are those that concern the "power to purchase." These two kinds of data are so interrelated that it is impossible to treat the one without the other. In some cases, the desire to possess will be restricted by the power to purchase; in others the power may be expanded to meet the desire; in still others the desire may far exceed the power. The ideal in marketing would be to arouse the desires that are within the power of the individual to satisfy. But modern advertising, through the widespread publicity that it creates, frequently arouses desires within the minds of its readers that are not within their power to satisfy. The consequences of too great a discrepancy between desires and the power to satisfy them was discussed in Chapter 24. It must be recognized, too, that there may be the power to purchase without the desire, as in the case of many persons who have an exaggerated tendency to save and accumulate capital, and in the case of segments of the population which have no interest in certain classes of commodities.

The power which has been referred to may be thought of as economic power or income, and as mental power or intellect. Although these two

kinds of power are not perfectly related, it will be satisfactory for our purpose to consider merely economic power and its bearing upon the distribution of goods.

FAMILY INCOME IN THE UNITED STATES

The distribution of economic power as represented by income is difficult to determine, but estimates have been made by the National Resources Planning Board (*461*) for families in the United States, covering the years 1935 and 1936. These data are set down in Table 56 which gives the income level, the number of families in each level,

TABLE 56

DISTRIBUTION OF INCOME BY FAMILIES *

Income Level	*Number*	*Per Cent*	*Cumulative Per Cent*	*Average per Family*
Dollars				*Dollars*
Under 500	4,178,284	14 2	14 2	312
500— 750	3,799,215	12 9	27.1	627
750— 1,000	4,277,048	14 6	41.7	874
1,000— 1,250	3,882,444	13 2	54.9	1,120
1,250— 1,500	2,865,472	9.8	64 7	1,364
1,500— 1,750	2,343,358	8 0	72.7	1,612
1,750— 2,000	1,897,037	6.4	79.1	1,829
2,000— 2,500	2,464,860	8 4	87 5	2,221
2,500— 3,000	1,314,199	4 5	92 0	2,715
3,000— 4,000	1,181,987	4 0	96 0	3,394
4,000— 5,000	402,595	1.4	97 4	4,391
5,000—10,000	510,010	1 7	99.1	6,874
10,000—15,000	131,821	0 4	99 5	11,353
15,000—20,000	58,487	0 2	99 7	17,331
20,000 and up	93,483	0.3	100 0	41,871
Total	29,400,300	100 0	....	1,622

* Adapted from National Resources Planning Board, *Family Expenditures in the United States* (Washington, D C, United States Government Printing Office, 1941).

the percentage of families in each level, the percentage of families at a given level or lower (cumulative percentage), and the average family income at each income level. Inspection of this table shows that the average annual income of the approximately thirty million families in the United States was $1,622 in 1935 and 1936. Since the average is heavily influenced by the relatively few extremely high income groups, the median income will be about $400 lower than the average, or about $1,200. This means that half the families of the

TABLE 57

Average Expenditures in Dollars for Main Items, 1935–1936 *

Income Level	*Per Cent*	*Cumulative Per Cent*	*Food*	*Shelter*			*Clothing*	*Transportation*		*Medical*	*Recreation*	*Personal Care*	*Tobacco*	*Education*	*Reading*	*Other Items*
				House	Service	Furnishing		Automobile	Other							
Under 500	14.2	14.2	203	90	57	9	35	15	3	22	6	9	9	2	4	2
500— 750	12.9	27.1	310	125	85	16	56	28	5	29	11	14	14	3	6	5
750— 1,000	14 6	41 7	380	161	106	27	78	44	9	38	17	18	19	4	9	4
1,000— 1,250	13 2	54 9	433	203	130	38	100	70	11	47	25	24	22	7	11	6
1,250— 1,500	9 8	64 7	487	230	149	48	123	93	14	57	31	27	27	9	14	7
1,500— 1,750	8 0	72 7	527	267	166	56	147	123	16	71	42	32	29	11	15	10
1,750— 2,000	6.4	79 1	558	302	186	68	164	154	18	79	49	35	33	15	16	7
2,000— 2,500	8 4	87 5	617	349	213	76	207	200	22	91	62	42	38	20	20	11
2,500— 3,000	4.5	92 0	690	404	260	84	255	242	24	109	81	49	41	30	22	11
3,000— 4,000	4 0	96 0	770	485	319	102	316	289	31	132	105	54	48	37	27	14
4,000— 5,000	1 4	97 4	852	571	400	110	408	382	35	158	136	66	53	57	31	17
5,000—10,000	1 7	99 1	1,038	784	584	158	557	522	48	248	206	89	62	83	41	34
10,000—15,000	0 4	99 5	1,214	1,204	761	227	829	681	114	227	340	114	79	227	57	23
15,000—20,000	0 2	99.7	1,785	1,490	1,179	277	1,265	919	399	413	486	156	104	537	69	52
20,000 and up	0.3	100 0	2,261	2,721	2,177	461	2,177	1,759	419	837	921	251	126	502	126	84
Total......	100.0	....	467	248	162	47	141	114	16	64	41	28	26	15	13	7

* From National Resources Planning Board, *Family Expenditures in the United States*, (Washington, D C., United States Government Printing Office, 1941), p 37

United States have received $1,200 or less per year. It can be estimated also that one-fourth of the families received in the neighborhood of $600 or less per year, and that three-fourths of the population have an income of about $1,750 or less per year. The satisfaction of desires for widely advertised and distributed commodities is definitely limited by income. The reader may satisfy himself as to the degree of such limitation by checking these incomes against the advertised prices of automobiles, radios, furniture, travel, and books.

FAMILY EXPENDITURES IN THE UNITED STATES

Further light will be thrown on the limitation of desire by a survey of how the typical income was spent in 1935 and 1936. The expenditures by families in the different income levels are gathered into Table 57. The figures for the lower income groups probably represent the irreducible minimum for such basic needs as food, shelter, and clothing (including fuel and light). Such economic facts as these cannot be ignored in the consideration of the nature of the consumer and what he needs and wants. For example, can the median individual afford to purchase and own an automobile, and if so, how much can he afford to pay for it, assuming that he buys it on the instalment plan and needs a new one every five years? The same question may be asked about many other commodities for which current methods of distribution stimulate a widespread desire. The document from which these statistics are drawn contains a wealth of data that warrant careful study by the psychologist who is interested in the problems of marketing. There are tables showing the distribution of expenditures in different sections of the country, in rural and urban communities, by whites and Negroes, and by families of different sizes. There is a minute analysis of expenditures for various articles of clothing, and by various members of the family, adults and children, males and females, for various kinds of recreation, and for luxuries of many sorts.

These interesting economic facts cannot be correctly interpreted when isolated from the psychological characteristics of the consumer. For, inseparably bound up with the power to purchase are such fundamental traits as the tendency to save or not to save money, to maintain a certain apparent standard of living at a sacrifice of other essential items of living, to pay only certain prices for given commodities, to buy certain things at specified places, to buy in particular amounts or in particular forms, to continue to use the same kind of article as used before, or to want something new and different. Some of these traits are fairly stable throughout a whole population; some of them are common to large classes of people, or to large geographical areas;

some are peculiar to individuals. With this simple statement of the need for knowledge of both the economic and the psychologic individual in its bearing upon the problems of marketing, primary consideration will be given to the psychological characteristics of the consumer and his wants.

THE DESIRES OF THE CONSUMER

All human beings have needs, wants, and desires that demand satisfaction. Some of these are bodily needs and comprise the essentials for maintaining life, such as the need for nourishment and for protection from danger. They are almost certainly inborn. It is not difficult to understand why these demands should exert such a powerful influence over behavior as they do. Other wants, which manifest themselves primarily in the relationships among individuals, are probably inborn also (Chapter 2). The so-called social needs are given a variety of names and are variously classified by different authorities. Their influence in determining behavior cannot be questioned, although the reasons for it are not so self-evident as in the case of bodily needs.

In their original form, these bodily and social needs manifest themselves in vague reactions and general restlessness. The means of satisfying them are not definitely specified by nature, but are the result of a process of adjustment which the individual undergoes from his earliest years. The few original needs are expanded, subdivided, and specialized, and the means of satisfying them are multiplied and diversified until they bear little resemblance to their origins. Thus the needs of the body for fluids may in the adult appear as a desire for a glass of water upon arising in the morning, a cup of coffee for breakfast, Coca Cola in the middle of the morning, buttermilk at lunch, tea in the afternoon, a cocktail before dinner, and a whiskey and soda after the theater at night. To be deprived of any of these, or the substitution of one for the other, will frequently cause annoyance. Likewise the social needs come to be satisfied in a very diverse manner by different people and at different times. The so-called tendency toward self-assertion may appear in the struggle for a position in the realm of science, athletics, business, industry, or fashion. In each of these it may take many specific forms, forms which are too obvious to need cataloguing.

ADVERTISING MOULDS DESIRES

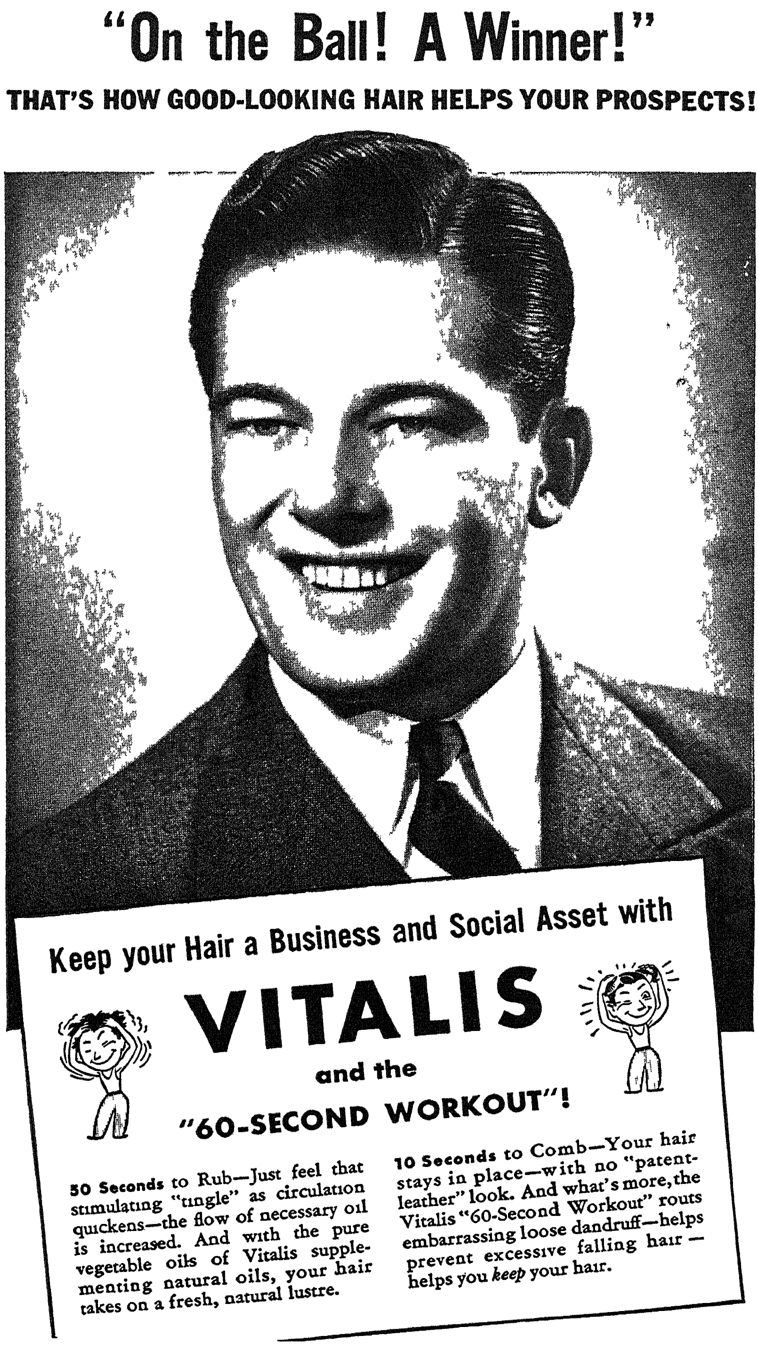
One of the most significant and powerful of the present-day forces in this educational process is advertising, broadly defined. Whenever the public can be educated into the acceptance of a given commodity as the best means of satisfying one of its needs, the success of that

FIGURE 103

TOOTH PASTE BRINGS SOCIAL SUCCESS

FIGURE 104

Portion of an Advertisement Appealing to Ambition



commodity as a marketing proposition is assured. The keen observer of marketing methods will have discovered a number of articles of commerce that have jumped into great prominence as household necessities not through the slightest change in the articles themselves, but merely because they have been demonstrated as satisfiers of a real want. The recognition of these facts has brought about a revolution in marketing methods. Thus, tooth paste is offered, not as a means of cleaning the teeth, but rather as an aid to success in the world of business or society (Figure 103). Soap brings love and happiness and not merely cleanliness to its users; correspondence courses no longer merely educate but prepare one to become a bank president or other high executive; furnaces and radiators do not merely heat the home but fill it with an atmosphere of hospitality. Many other illustrations might be given to show how goods may be represented as satisfiers. Not all are successful, for it requires a high degree of skill and ingenuity to show how a new product will satisfy an old need in an entirely unexpected and unusual way. Success, however, carries with it a large reward.

As these needs have been considered in Chapter 2, only one or two of them will be mentioned for purposes of illustration. One of the most consistently exploited of them is the desire to conform, or be like others. The desire of every one to have what his neighbor has is recognized as a most powerful aid in the expansion of markets. Advertising is one of the many publicity devices that make all men neighbors and enlarge their demands accordingly, and it is one of the most effective of them. Motion pictures, the radio, newspapers, magazines, automobiles and now television are unintentional allies of advertising in this process of expansion of acquaintanceship of all classes and all peoples.

Closely related to this desire to conform is another that is susceptible of satisfaction in the greatest variety of ways, and that has been effectively played upon for the purpose of marketing new commodities. It is called ambition, and leads one to do a little better than his neighbor, and just as well as those that are above him. Almost any magazine or newspaper will yield specimens of advertising that profit by the strength of this distinctly human need. Figure 104 demonstrates how a hair tonic is marketed through an appeal to business ambition. As ambition is universally present in some one or more of its many forms, and as it is practically never entirely satisfied, it constitutes a powerful spur to action.

When a desire for some object or end has been excited by advertising or any other means, then the consummation of it brings satisfaction. It is in this sense of fulfilling people's needs, and thus giving them

satisfaction whether by means new or old, novel or commonplace, that marketing constitutes service.

RELATIVE STRENGTH OF DESIRES

This brief examination of the consumer, his needs, and the motives that impel him to buy, shows that any article of commerce may be made to satisfy one or more of a variety of desires. An analysis of soap advertising has disclosed the fact that different brands were presuming to satisfy seventeen different basic desires, such as a desire for cleanliness, health, comfort, beauty, youth, social prestige, and love. Other products have been found to make an equally variegated offering. In fact, the range of appeals that may be employed in marketing a product is limited only by the ingenuity of its promoter. Naturally some appeals are more effective than others. To determine which is the best appeal to use for a given purpose is almost as complicated as solving a difficult mathematical equation, because of the number of variables involved.

Foremost among the variables to be considered is the relative strength of the different appeals, or rather the relative motive force of the wants aroused by the appeals. It is not safe to make more than very tentative generalizations from the objective studies of the strength of impulses in animals, where the largest amount of work has been done on this subject (*677*), although fruitful hints as to techniques have been derived from them. The earliest measurements of human desires relied on subjective report. Persons were asked to state, with the help of one of the rating methods such as were described in Chapter 14, what is the relative potency of the various desires in guiding their own actions. Such judgments are not impossible to make and yield some interesting results which check favorably against marketing returns (*501*, 86-102). For instance, the desire for food, for protection, and the love of offspring always stand high. Next to these come the social tendencies such as sociability, imitation, and hospitality, and finally the appeals that do not tap any real personal interests such as guarantee, reputation of the firm, and danger from substitutes. Thorndike (*626*, 96-182) has employed an indirect method of gauging the strength of desires in terms of how much money or how much leisure time one will be willing to spend in satisfying them. Some of his data obtained in this fashion were reproduced in Chapter 2.

Out of the many laboratory studies of appeals, that of Osgood, Allen, and Odbert (*476*), has a particular interest. They presented a series of appeals for specific commodities by means of phonograph records, and through statistical manipulation isolated the effect of the appeal from

the particular brand with which it had been associated. They derived the following order of effectiveness, the most effective being first in the list:

1. Self-esteem	6. Efficiency
2. Prestige	7. Economy
3. Health	8. Beauty
4. Universality	9 Safety
5. Sex	10. Comfort

The study of radio programs and their listeners has been proposed by Lazarsfeld (*369*) as a somewhat more direct means of measuring appeals. If programs can be classified according to the motives they appeal to and if the number of listeners can be determined for each, then it may be inferred that the program drawing the largest audience has the strongest appeal. Tentative explorations in this direction have given promising results.

Nixon (*467*) has measured the relative strength of appeals as used in advertising by observing directly what a person looks at when confronted with a choice of stimuli. Nixon's technique has recently been carried several steps further toward objectivity by Karslake (*334*), who takes motion pictures simultaneously of the eye and of the object toward which it is directed. These more refined and more objective techniques confirm in the main the findings of the earlier subjective methods. They are mentioned here, however, not so much for the results that have already been obtained by their use, as for their promise as tools with which to make more extensive surveys.

In addition to the strength of the impulse aroused by the abstract appeal, its appropriateness for the particular commodity must be discovered. Some appeals are obviously poorly suited to certain products whereas others are just as obviously well suited. For instance, where economy might be an important point in regard to laundry soap, it is of practically no consequence in connection with perfumes. Health-giving qualities, together with cleanliness, however, have attained a high standing in all the tests of the strength of appeals that have been published, and underlie the successful marketing of a wide range of commodities.

An appeal will not be successful if it has been used frequently before for the same purpose, even if it happens to be, in general, a very powerful one. Uniqueness and distinctiveness are essential factors that must be added to strength in every successful appeal.

When the appeal has been chosen to satisfy the conditions just outlined, it must be put into words and pictures. Here, too, a good appeal may be ruined and a poor one much improved by the way in which

it is presented. On account of the presence of all these variables, it is expedient not to rely too much upon the theoretical expectation of strength in the appeal. It is here that the methods of Nixon and Karlslake can make a contribution since they measure the reactions to actual advertisements. The last stage in any evaluation of appeals, however, should be a test of strength upon a sampling of consumers. This may be done by the test campaign familiar in advertising procedure which makes use of opinion polls, "brand barometers," radio audience surveys, and sales records.

THE HABITS OF THE CONSUMER

The fact that the means of satisfying desires are largely the product of education offers an unlimited field for the development of markets for new commodities and new markets for old commodities, but at the same time it introduces obstacles in the way of such development because of the fixity of habits after they have been established. The promoter of one commodity counts on the fixity of habit for maintaining a market for his goods, whereas his competitor counts on the force of education to turn the consumer to his own product. The resistance that a new product has to meet is seldom sufficiently understood. No matter how convenient, economical, healthful, or pleasing it may be, it will meet a strong tendency to continue the use of the more familiar article. The purchaser may even make a resolution that, when the need next arises, the new commodity will be purchased, but habits of mind as well as of action will frequently make the resolution ineffective. The years of publicity and education that were required to bring about a general use of the safety razor defy explanation except in terms of deeply rooted habits. The electric razor will have the same problem in breaking down present habit patterns. Resistance offered to the adoption of substitutes for shaving soap, of paper dishes, of fireless cookers, and hundreds of other labor- and money-saving devices for home, office, and factory must be accounted for in the same way.

Habits determine not merely what article shall be bought, but where it shall be bought, how much shall be paid for it, how much shall be bought at a time, whether in package form or loose. To be asked to pay $2.50 for a watch that one is accustomed to think of as a dollar watch, or $7 for shoes that have previously been bought for $4, will meet resistance, no matter how legitimate the increase may be in terms of the decrease in value of the dollar. Likewise, to be offered an oriental rug for $25, when one has been accustomed to think of it as an expensive luxury, will arouse opposition and perhaps suspicion. In fact, any changes in response to old situations will be made with a degree of

difficulty which depends upon the fixity of the attitude toward them.

Habits peculiar to individuals, naturally, cannot be taken into account in general advertising, but there are many habits that are common to masses of people, to social classes, to geographical districts, and to occupational groups. These should be discovered and allowed for. The *salesman* will do well to know as much as possible about the habits of his customers, both in order to satisfy them and to rebuild them when necessary. It is just as necessary for the *advertiser* to know group habits in order that he may deal with them intelligently in his printed message.

Finally, it should be remembered by both the advertiser and the salesman that to perform habitual acts without interference gives satisfaction, and to be interfered with in their performance causes dissatisfaction just as surely as furthering and hindering the more natural tendencies to action cause satisfaction and dissatisfaction.

THE LOGIC OF THE CONSUMER

Do the needs arising from natural tendencies and from habits constitute the sole source of the buying motive? It is commonly supposed that reasoning or cool calculation plays some part in determining these reactions, that some decisions are made after a process of deliberation. Since the analysis of human behavior shows that actions based on logic are rare, one should not expect to find them playing a very prominent rôle in buying. In fact, where one seems to be reasoning out his actions he is seldom really doing so. Any perfectly honest observer of his own behavior can discover this fact for himself. His everyday purchases certainly are the result of habits or needs that are never put to any logical test. Even the more unusual investments and those which involve a considerable expenditure are very frequently "impulsive." A person wants to own a certain type of automobile or radio. It is costly and far more elaborate than necessary for the use that it will receive. Another, cheaper one will do as well. Arguments can be found, however to support the desire, and the expensive one will be bought. Such reactions, much as they seem like reasoned ones, are not strictly so. The decision is not made after a process of deliberation. It is made first and is based directly on desire. Deliberation then furnishes support for the action already determined. This artificial type of reasoning is widespread and can be found at work in every level of intelligence. It is known as rationalization (Chapter 5).

There are cases, of course, where reasoning plays a part, and these are to be found especially in the purchase of tools, instruments, and equipment. where the economic factor predominates. and where the logic

is largely one of dollars and cents. But even in purchases of this sort the more "human" appeals are found to be effective. It is one of the achievements of the marketing expert that he can inject into such strictly colorless and prosaic objects as a heating plant much of the personal and social quality that attaches to the more intimate things of life, and thus transfer this purchase from the realm of logic to that of unreasoned desire.

26

The Adjustment of Advertising and Selling Methods to the Consumer

If the marketing problem from the psychological point of view is conceived as a problem of service to the consumer, and if service means giving the consumer what he wants, how may this service be most readily and effectively rendered? To know what the consumer wants is the first essential, but the manner of telling him what will satisfy his wants, and especially of convincing him that a particular commodity will satisfy his wants best, is almost as important. In order to present this message most forcibly, one must know all the conditions upon which a complete grasp of it depends, and all the factors that will further a favorable reaction to it. He must know as much as possible about the degree of comprehension that he can expect to find in his audience; the level of language that they can understand; how sharply they are able or are accustomed to discriminate among commodities or the names of them; what they like and dislike; what are their beliefs, both those that are firmly rooted and not to be tampered with and those that are susceptible to change; and how long they can be expected to remember what they read in an advertisement or see in a store display. These are only a few of the items of information that are needed to protect the advertiser from shooting over the head of his market, from arousing its antagonism, or from expecting greater susceptibility than will be forthcoming. A few of these characteristics of people will be surveyed in the following pages.

WHAT CAN THE CONSUMER COMPREHEND?

In presenting the marketing message it is vital to know what the consumer can comprehend, and to prepare it accordingly. Any casual estimate of comprehension is very likely to go astray, because every one is inclined to think of other persons as being more or less like

himself. In writing an advertising message for a large section of the population, there is great likelihood of overrating the comprehension of its readers. In fact it was difficult, if not impossible, to realize what the bulk of the population could be counted on to grasp in the way of a printed message until the intelligence survey was made during the first World War. Not only was the percentage of illiteracy surprisingly large, but the percentage of people who could read only with difficulty was very much larger. The distribution of the ability to comprehend printed symbols, therefore, takes on considerable importance in the case of the advertising of widely used commodities, such as foodstuffs and soaps.

Some idea of the way in which this ability is distributed in the population of the United States may be obtained from records of the Army Alpha intelligence examination where the score is expressed in terms of chronological age. Such data are given in Table 58. In the first column are the customary letter grades indicating the various levels of intelli-

TABLE 58

DISTRIBUTION OF INTELLIGENCE

Intelligence Grade	*Percentage of Cases*	*Equivalent Age in Years*
A	3.5	18.0 to 19.5
B	7.5	16.5 to 18.0
C +	13.5	15.0 to 16.5
C	21.5	13.0 to 15.0
C −	22.0	11.0 to 13.0
D	22.0	9.5 to 11.0
D −, E	10.0	0 to 9.5

gence. In the second column are the figures showing the percentage of the population falling within that grade; and in the third column the grades are expressed in terms of the average age of persons in whom this degree of comprehension can be found. Since our interest is in the ability to comprehend printed symbols, our conclusions will be free from the criticisms that are frequently directed against intelligence measures. The average individual in the United States has a comprehension equal to that of a thirteen- to fifteen-year-old person, while the lowest 25 per cent of the population will approximate the ten-year-old child in comprehension. If one wishes, therefore, to print a message that will reach 75 per cent of the population, it must be written as to a child of ten years. In the army it was found inadvisable to expect the lowest 25 per cent of the recruits to read and understand printed instructions.

The average vocabulary of persons of different ages has been calculated as follows:

	Number of Words
Superior adult	13,500
Average adult	11,000
Twelve years .. .	7,200
Ten years	5,400
Eight years	3,600

These are probably very generous estimates. It is safe to assume in the light of these figures that, when a superior adult writes for the comprehension of as much as 75 per cent of the population, he must limit his vocabulary to less than half of its customary range.

When actual experimental tests (*496*) are conducted to find out how closely written advertisements are adjusted to their readers, many avoidable discrepancies are found between the character of the message and the degree of comprehension of the readers addressed. Not only are many words used that are not comprehended, but sentence structure is often too complicated and the ideas contained in them are too complex to be readily grasped. The current tendency to use highly technical and scientific terms in advertising is not justified by a knowledge of the distribution of the ability to comprehend them.

Kitson (*341*, 54) has proposed to determine how advertisements should be written by studying the character of the other printed matter in the medium carrying the advertising. His assumption is undoubtedly sound that the news-story content of a magazine or newspaper must be adjusted to the comprehension of the reader or it will fail. Advertising, to appear in the same medium, should be prepared for the same level of comprehension. Using word length and sentence length as indicators of the character of the material, he compared various media and found interesting differences in both these respects. For instance, one magazine had 59 per cent more three-syllable words than another, and 33 per cent more sentences containing twenty or more words than another. Also a certain newspaper had 70 per cent more three-syllable words and 13 per cent more sentences of more than twenty words than another. Such data represent interesting adjustments to the comprehension of readers and should be reflected in the advertisements.

In the light of the small amount of data that are available, it is wise to err on the safe side and "write down" to the advertising audience. A lesson may be learned, also, from the universal appeal of motion pictures and the picture newspapers, that a story can be told in pictures with a minimum of word symbols when it is necessary to do so. Whenever an extremely wide distribution of the population is to be

reached a generous use of pictures is advisable, as on billboards, for even illiterates can be reached through the message of the picture. One can buy Camel cigarettes, Barking Dog tobacco, Cow Brand baking soda, special brands of crackers, soaps, and many other commodities with only a meager comprehension of printed symbols.

The radio advertiser does not escape the problem of meeting the comprehension level of his audience. On the contrary, many new questions arise in adjusting the spoken word to the range of intelligence comprising the potential market for a widely used commodity. There is just as much likelihood of talking above an audience as of writing above it. Length and form of sentence may have a greater influence upon understanding material that is spoken than material that is read because of the nature of auditory attention. Some of the problems peculiar to radio advertising will be discussed in the followifig chapter.

WHAT CAN THE CONSUMER DISCRIMINATE?

The power and habits of discrimination of the consumer enter into the buying reaction in a multitude of ways. As to the commodity itself, what differences in its quality, quantity, pattern, texture, or size are distinguishable in the everyday contact with it? Are there more sizes and grades of things than can be discriminated readily? It is evident that the development of a stock of goods based upon easily noticeable and practicable differences would lead to the reduction in the variety of many lines of commodities. This is especially true in grades of textiles and papers, the sizes of screws, nails, and other hardware. On the other hand, the application of the facts of discrimination would lead to the adoption of finer gradations of quality and size in some cases. The introduction of quarter sizes in men's collars, for example, was a needed innovation and illustrates the value of taking the consumer into account in planning merchandise. There is scarcely any line of goods that would not profit from a survey of the capacity of the consumer to discriminate among its varieties.

DISCRIMINATION OF TRADE-NAMES

The discrimination of the consumer enters into the marketing problem in another way. It is a commonplace of marketing technique that a newly introduced commodity should be distinctive in name and container at least, so that it will not be confused with other similar products already on the market. Likewise, the characteristics of an advertisement of one article should not lead to confusion with another article. And yet both of these errors occur, because the discriminative power of

the consumer is far overrated. Barring the cases where confusion is deliberate, in order that one product may prosper through the prestige of another, such costly mistakes could be avoided by careful examination of the facts of discrimination. The most abundant data on this question are to be obtained from the trade-mark and trade-name litigation, where confusion has been so great as to damage the interests of one or the other commodity. Attention has been directed especially to finding some ready means of measuring confusion arising through the inability to discriminate between various trade-names or trade-marks, but it would be far more profitable to measure the possibility of confusion as a preventive rather than as a means of settling legal disputes.

TABLE 59

DISCRIMINATION AMONG TRADE-NAMES *

Original	*Imitation*	*Percentage of Confusion*	*Legal Decision*
Sozodont	Kalodont	28	Non-infringement
Nox-all	Non-X-Ell	28	Infringement
Club	Chancellor Club	35	Infringement
Bestyette	Veribest	35	Non-infringement
Mother's	Grand-Ma's	38	Non-infringement
Au-to-do	Autola	40	Infringement
Peptenzyme	Pinozyme	43	Non-infringement
Green River	Green Ribbon	50	Infringement
Ceresota	Cressota	63	Infringement

* Adapted from R H Paynter, "A Psychological Study of Trade-Mark Infringement," *Arch Psychol.* (New York), 1920, No 42, 69.

The efforts of Paynter (*489*) to measure confusion empirically and to create a scale for the purpose, demonstrate the possibilities of psychological technique in solving such problems. He was able to show that legal decisions do not necessarily conform to objectively measured confusion, as indicated in Table 59. The percentage of confusion means the percentage of people who confused the imitation and the original from its appearance and sound. The meanings of the other columns will be clear from their headings.

In the planning and construction of advertisements, what importance is to be attached to certain costly innovations in terms of the ability of the observer to perceive them? Who can distinguish between a certain type face and another that is one-half point smaller in his ordinary contact with it? Can the average reader of an advertisement distinguish among three-color, four-color, and six-color printing? The cost differential of these color processes is too great to pass unnoticed.

Are the more costly forms of art that are so prized by the advertiser distinguishable from the simpler and cheaper forms? These are all questions that the expert can answer for himself, but they cannot be answered at present for the three-fourths of the population that is to see them. Answers can be found, however, through carefully controlled psychological inquiry.

DISCRIMINATION OF SIZE

The problem of the size of advertising space to be used is reducible largely to the psychological question of discrimination. Large space is used mainly for getting and holding attention, and attention depends upon noticeable difference or distinctiveness. An advertisement will attract attention by size, not because it is big, but because it is *bigger* than its neighbors and competitors. This means simply that as far as attention is concerned, it is *relative* size and not absolute size in square inches that counts (*463*). A half page has a certain attention power whether it be half of a large page or half of a small page. Nixon (*467*), as well as a number of other investigators, has shown that the greater the relative difference in size, the more readily will the larger advertisement be discriminated and attract attention away from its neighbors. How much larger one advertisement should be than another, and whether the distinctiveness thus attained is worth what it costs, are economic rather than psychological questions. Consideration should always be given to the possibility of getting the desired amount of distinctiveness in a more economical manner than by the use of large size. For there are many ways of attaining distinction, such as the use of color and color combinations, unique forms of illustration or typography, unique position on the page or in the advertising medium, and unusual kind of copy. It has been our purpose merely to point out the psychological character of the size problem and to suggest the wide range of questions that may be answered through the application of the facts of discrimination to the field of advertising.

WHAT ARE THE CONSUMER'S LIKES AND DISLIKES?

Modern psychology has recognized that the feelings form the vast undercurrent of life, influencing the course of behavior in manifold ways. It is a primary law of behavior that one continues doing or repeats those acts that are pleasant, and inhibits or avoids doing those things that are unpleasant. For this reason the feelings have a very important relation to the processes of attention, interest, and memory. In some instances the character of the feelings is surprisingly uniform

for all people, as in the pleasantness and unpleasantness of certain tastes, odors, and sounds. In other cases, the quality of the feelings aroused in a specific situation is peculiar to the individual and is the result of certain unique experiences. Such idiosyncrasies in the way of tastes, preferences, likes, and dislikes will form valuable data for the salesman, since arousing pleasant rather than unpleasant reactions in any way whatever may mean successful service to the customer. Cason's (*92*) list of the likes and dislikes of people described in Chapter 24 would make valuable reading for any one whose duties bring him into contact with people. Although such individual tastes cannot be appealed to in advertising, there are others that are sufficiently widespread to be counted on for this purpose.

AESTHETIC PREFERENCES

Certain of the feeling reactions have long been recognized and are incorporated into the subject-matter of aesthetics, such as the pleasantness of colors and color combinations, of lines and curves, and of areas of specified proportions. In fact, the whole realm of aesthetics can be profitably searched for sources of pleasantness in advertising material. Experimental studies are often required, however, to find just what colors or color combinations, lines, or type faces will give the most pleasing effect for a specific purpose. The few studies that have been made show clearly that there are measurable differences in the effects produced by simple changes of proportion, line, and color. For instance, Collins (*107*) has demonstrated that, although the combinations of yellow with blue, and of red with green are preferred over other combinations merely as colors, by men and women alike, they are not the most preferred combinations for advertising particular commodities. Table 60 gives the most frequently preferred color combination

TABLE 60

COLOR PREFERENCES FOR SPECIFIC PURPOSES *

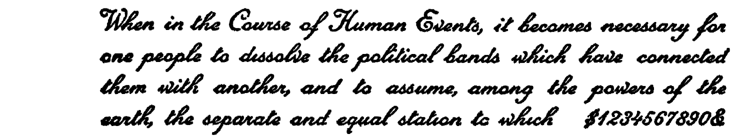
Article to be Advertised	*Combination Most Preferred*
Building material	Yellow and orange
Jewelry	Yellow and purple
Breakfast food	Yellow and orange
Perfume	Yellow and purple
Coffee	Yellow and orange
Schools	Yellow and orange
Soap	Yellow and green
Summer camps	Yellow and green
Candy	Red and yellow
Summer beverages	Yellow and green

* From N Collins, *The Appropriateness of Certain Color Combinations in Advertising*, Unpublished Master's Thesis, Columbia University, New York, 1924.

for ten different articles, in the opinion of one hundred persons. In some of these cases there is a rather wide variation in choice, whereas in others there is close agreement. Facts such as these can only be found out by experimental study.

FIGURE 105

RELATIVE APPROPRIATENESS OF A TYPE FACE FOR DIFFERENT PURPOSES *



Cheapness	28	Automobiles	29
Dignity	5	Building Material	29
Economy	26	Coffee	29
Luxury	3	Jewelry	2
Strength	29	Perfume	1

* From A. T. Poffenberger and R. B Franken, "A Study of the Appropriateness of Type Faces," *J Appl Psychol*, 1923, *7*, 320

Results similar to this were obtained by Poffenberger and Franken (*504*) from a study of the appropriateness of type faces for specific advertising purposes. The form of script reproduced in Figure 105 was found to vary markedly in appropriateness for expressing five different abstract qualities, and for carrying the atmosphere of five different commodities. The numbers given below the type specimen refer to the order of appropriateness among twenty-nine specimens of type included in the study, hence the nearer the number is to 1 the more appropriate, and the nearer to 29 the less appropriate. The figures for this one type face show that although the script was the most appropriate of the whole twenty-nine specimens for perfume, it was the least appropriate of them all for automobiles, building material, and coffee. Any one who looks over a collection of current advertisements will see in them definite attempts to adjust type quality to the commodity advertised with much or little success. Here, as elsewhere, the judgments of individuals may be erroneous so that the final test of appropriateness must be the favorable or unfavorable reaction of an adequate sampling of consumers.

Davis and Smith (*130*) have attempted an experimental analysis of type faces in order to discover what aspects of them determine their peculiar appropriateness for a given purpose. They employed a technique very similar to that of Poffenberger and Franken, having subjects both match type specimens to qualities and match qualities to type faces. Not only did the investigators find certain kinds of type faces more appropriate than others to express a given quality, but they found differences also among the variants within a given type

face. Size appeared to be the most important variable, with condensation, boldness, and italics following in that order.

There is good reason to believe that many other aspects of advertising matter can be so chosen as to heighten the pleasant feeling-tone which it will arouse. This is especially true in the case of the choice of trade-names and slogans. With the modern tendency to create new words as names for products, it would be a simple matter to take account of the feelings that such words arouse. The safest way is to ascertain the feeling-tone of a proposed word before adopting it, both by analyzing it for obvious unpleasant associations and by testing it upon a good-sized sampling of people (*501*, 460-475).

PREFERENCES FOR ADVERTISING MEDIA AND LOCATION

The likes, dislikes, tastes, and preferences of the consumer enter into the advertising problem in the selection of an advertising medium and the choice of location in that medium. Surveys of magazines and newspapers indicate differences in the interests and tastes of their subscribers. This is especially obvious in the case of class, sport, and other specialty publications. But it is true also in the case of newspapers, where the preference of the professional class inclines toward one, that of the financial class toward another, and that of the labor class toward still another. As far as the general public is concerned, the newspaper offers the most universal medium of approach. A survey (*501*, 598-602) of a typical American city showed that, whereas magazine circulation was limited largely to professional and executive groups, so that unskilled workmen comprising about half of the population received only about one-twelfth of the magazines, practically every family in the city received a newspaper.

The preferences and tastes of the consumer can be capitalized in the choice of position in the medium as well as in the choice of the medium itself. Advertisements that are directed to those interested in sport will profit from their association with sport news, financial advertisements with financial news, and radio advertisements with radio news. The value of such spatial association is not merely in the fact that the chances of being seen by the proper group are enhanced, but by the fact that the advertisements so placed will find their readers in a most susceptible and suggestible mood. Use is already made of these facts in both advertising and selling, but they will find a still wider range of application when the results of psychological analysis are made available concerning the variation of tastes according to sex, age, occupation, social status, and geographical distribution.

WHAT DOES THE CONSUMER BELIEVE?

There is just as great danger of misapprehending the beliefs of the average individual and his basis for them as there is of misjudging his intelligence. It is difficult to realize, without definite inquiry into the subject, what people believe and can be made to believe. A great deal of interest has been aroused in this question of beliefs and their basis on account of the ease with which seemingly intelligent persons can be induced to purchase worthless securities and stake their money on propositions where the chances are a thousand to one against them. Drastic state legislation and the constant vigilance of public-spirited business organizations do not always suffice to prevent exploiting the credulity of the public. A thorough understanding of the mechanism of belief will, however, not only show how ill-founded beliefs may be eradicated and prevented, but it will show also how correct beliefs may be established. It is this latter aspect that has the greatest import for advertising.

The difficulty that is encountered in the attempt to substitute scientifically established facts for superstitions and to prevent the spread of superstition tends to give additional interest to the search for the basis of beliefs. Even among fairly well-educated people superstitions abound, as several inquiries have demonstrated. One of these (*113*) showed that, of a large group of college students questioned, about 50 per cent acknowledged superstitious beliefs and practices. Another inquiry (*468*) among 350 college students revealed similar results. Leaving out of consideration such superstitions as that "Friday is an unlucky day" and such controversial statements as "intelligence is increased by training," it was found that 46 per cent believed that "if you will stare at a person's back you can make him turn around. This is a form of telepathy"; 42 per cent believed "a square jaw is a sign of will-power"; 18 per cent believed that "people born under the influence of certain planets show the influence in their characters."

A study of the mechanism of beliefs in general, and particularly as they are created by advertising, shows that feeling and emotion, rather than reason, play a dominant rôle. Belief is a matter of desire and not of logic (*389*). We believe what we want to believe. Hence it is to be expected that the statement of the truth in advertising or elsewhere will not assure belief. To give a person what he wants and at the same time to arouse a glow of emotion will go far toward creating belief. There are two other factors that should not be neglected. First, any statements that are made should not conflict too sharply with already established beliefs. To create new beliefs contrary to old ones is like breaking old habits and forming new ones, and meets just as much resistance. Second, all statements intended to generate belief should carry

the weight of some authority behind them. Herein lies the value of testimonials of great and well-known persons (*497*).

WHAT CAN THE CONSUMER REMEMBER?

Any advertising or selling device that is to furnish a genuine and lasting service must make an enduring impression upon the memory, for there is practically no case where there is not at least some small gap between the marketing effort and the contemplated reaction. The laws of learning and memory which have been discussed in Chapter 4 have made the reader familiar with the means of making impressions permanent. It will be profitable, in addition, to analyze a case of memory for advertising material, to discover, if possible, the potent factors.

TABLE 61

RELATIVE MEMORY VALUE OF TRADE-NAMES *

Tooth Paste	*Number of Responses*
Colgate	539
Pebeco	129
Pepsodent	104
Kolynos	66
Dr Lyon's	13
Forhans	12
Klenzo	10
Senreco	8
Peredixo	7
Williams	6
Miscellaneous	52
Blank	78
Total	1,024

* From G. B. Hotchkiss and R B Franken, *The Leadership of Advertised Brands* (New York, Doubleday, Page and Co , 1923), p 226

A list of commodity names was presented to people with the request that they mention the first trade-name that came to mind. Now this is exactly the type of memory that the advertiser wants to guarantee, because it means that, when the need for something arises, his particular brand will offer itself to fulfil it. It does not mean necessarily that the particular brand that comes to mind first will always be bought, for there are many factors that combine to determine the actual purchase. But it is certain that the trade-named article that does not come to mind will not be bought.

Hotchkiss and Franken (*293*), in the data gathered into Table 61. give the trade-names mentioned by 1,024 persons to the stimulus word "tooth paste," and reveal an interesting picture of the familiarity of the

consumer with these different brands in the years 1917-21 when the experiments were made. Over thirty different brands were mentioned. The brand that stands first in the list was mentioned just about five times as often as the one that stands second. In fact, over one-half of all the people called this brand to mind first. The leading four brands were mentioned more than four-fifths of the time, leaving only about two hundred responses to be divided among the twenty-five other brands. An analysis of the history of the best known brands of tooth paste and the other commodities revealed the following points:

1. All these brands have been on the market for a long time and many of them are the pioneers in their respective fields.
2. Nearly all are extensively advertised, and nearly every one is the pioneer large advertiser in its field.
3. Nearly every one has been a persistent advertiser during the last ten years.
4. Each one is the largest, or nearly the largest, seller in its field.
5. Nearly all are frequently used commodities
6. All are products of standard quality and of good reputation.

Of all the devices that cause advertising to be remembered, two stand out clearly from this analysis, namely, primacy and repetition. Of the former little need be said, as one cannot be first in the field of competition by merely wishing it, and at the best it is a matter of good fortune. Repetition, however, is available for all to use, and is limited only by its cost. There is a certain characteristic of repetition that has been demonstrated both in laboratory studies of the psychology of learning and in advertising, namely, that the memory effects of succeeding repetitions become smaller and smaller. It is this fact that gives learning curves their characteristic shape. The reasons for the decreased efficiency of later repetitions as compared with the earlier ones are numerous and complex, and for our purpose need not be examined. Studies of the effects of repetition upon the memory for advertising material show that the "diminution of returns" is quite as great as in the more theoretical studies.

Strong (*592*) conducted an elaborate research on the effects of repetition, in which he duplicated as far as possible the conditions that obtain in advertising. He prepared four pamphlets simulating the advertising sections of four numbers of a magazine. Certain advertisements appeared in only one number, certain others appeared in two of them, whereas others appeared in the four numbers. All the pamphlets were examined at specified intervals by a group of subjects with the result that some of the advertisements were seen once, some twice, and some four times. The subjects were tested for their knowledge of the advertisements after the last number had been examined. Among

other interesting discoveries, he found that two repetitions are worth, not twice as much as one, but only about 25 per cent more, and that four repetitions are worth, not four times as much as one, but only about 60 per cent more than one.

The advantages of repetition may be retained and its disadvantages counteracted by the introduction of other aids to memory. Thus, it has been found that, if certain unique characters are introduced at every repetition, each will take on the freshness and vividness of a first presentation and raise the memory value of the advertisement considerably. In one study in which all repeated material was varied, four repetitions were worth a little more than four times as much as one, in terms of memory value. This great increase in the value of repetitions is owing to the well-known fact of learning, that mere repetition without interest loses its potency. The introduction of new material stirs the interest which would otherwise decrease, and makes the whole experience more vivid.

THE PSYCHOLOGY OF SALESMANSHIP

It is necessary to make a distinction between two methods of delivering a message to the consumer, namely, advertising and direct selling. They differ in that the former is a project directed at large masses of people, whereas the latter is directed at the individual, and in that the former makes only an indirect contact with people through the medium of a printed message whereas the latter makes direct contact between the buyer and the seller. In advertising, the modification of the tactics of selling to suit the individual prospect is out of the question but in selling that very modification is essential to success.

As a consequence of these differences between the two marketing methods, the advertiser must play upon the human needs that are common to large groups and must avoid appeals that would be effective only for particular persons or small groups. The salesman, on the other hand, needs to know not only the traits that are universally present, but he must learn as much as possible about the particular individual prospect. If illustration of this difference is needed, it will be furnished by comparison of the advertisement in Figure 106 with the data reproduced below, which were used in selling an insurance prospect. The advertisement uses every device that the printed page will afford to simulate the direct appeal by one person to another. It dwells upon the need of protection "no matter who you are, where you live, what you do, whether man or woman." It counts on family affection and the uncertainties of life to be universally present, and makes a general appeal on the basis of these two facts. A typical list furnished by Strong

(*598, 24*) of the kind of intimate details in the life of a prospect which a good personal salesman will aim to have at his command stands in sharp contrast with the advertisement.

Carter C. Barnes, dentist, Middletown, Conn.
Age, 36 in 1919, born May 25, 1883.
Has $3,000 twenty-premium life in this company, taken out at age of 30. No other insurance known.
Married—has three young children, a boy and two girls.
Now practices alone, but until recently was associated with an elder dentist, Dr. Warden
Income unknown, probably about $3,500 or $4,000.
Graduate of local college, Wesleyan University, takes an active interest in college affairs and in his fraternity, Psi Upsilon. Is a member of the Methodist Church, the Country Club, and the University Club.
Wife has inherited $35,000 from an uncle, according to the papers.

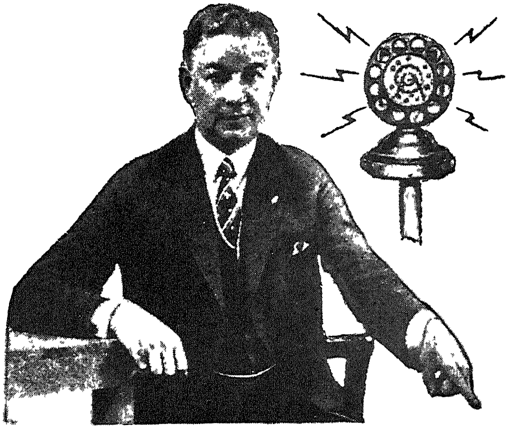
THE TASK OF SELLING

Very little of the psychological research in the field of marketing has been devoted to the process of direct selling. The reason for this resides mainly in the relative inaccessibility of the data of selling compared with those of advertising. The materials of advertising lend themselves with special readiness to the analysis and experimental methods of the laboratory. Printed appeals may be collected, presented, handled, dissected, preserved, and studied over long periods of time and under constant or known conditions. The oral appeal of the personal salesman offers problems of far greater complexity. From its very nature the sales talk represents a continuous process of which the printed advertisement is but a cross section. When the advertisement is presented its influence is determined once for all, and it is either relatively successful or relatively futile. But the oral salesman, working at close range and face to face with his customer, may choose his appeal, vary it, repeat or supplement it according to the particular idiosyncrasy of the customer and according to the time and circumstance of the interview. The oral sales talk is to the printed advertisement what the motion picture film is to the simple lantern slide, the drama to the tableau, or the kaleidoscope to the frozen frost pattern. The sales talk is a whole advertising campaign condensed into a few moments and adjusted and adapted to the present responses of the audience. It is not restricted to its verbal dress, but is reinforced, emphasized, or otherwise modified by the personality of the salesman, his appearance, voice, dress, bearing, expression, intonation, and gesture. Once it is finished it may never occur again in precisely the same form or under precisely the same conditions.

FIGURE 106

PERSONAL APPEAL IN AN ADVERTISEMENT

"This is Schaffer
The Insurance Man Speaking to You!"



Broadcasting from Coast to Coast
"You may be next"
(You never can tell)
To Every Reader—Attention!!

INSTEAD OF knocking at your door—I address you through the public press. I am your best friend in time of need. I AM THE INSURANCE MAN. And what I have to offer, you really need. Daily the newspapers report casualties of every sort. Then, why gamble with life's uncertainties when so much is at stake. Insurance is indeed "an ounce of prevention" rather than a "pound of cure." Not only as a financial safeguard; it is economical as well. The policy that I am offering you will not prevent an accident nor stave off sickness, but will help pay all bills incidental to same, and a substantial amount for a fatality. SAFETY FIRST! YES, BUT INCLUDE PREPAREDNESS, TOO. The saddest cases of all are those who fail to protect themselves with Insurance. I firmly believe it is every responsible man's and woman's duty to be protected by Insurance. The protection of Insurance is the best way to soften the brutal shock of unforeseen disaster.

For years I have hammered away in the columns of this paper the importance and necessity of INSURANCE PROTECTION. Thousands have heeded my advice, but thousands upon thousands of persons have as yet failed to obtain one of these policies, and this message of mine is directed to them. No matter who you are—Where you live—What you do—Whether man or woman—YOU NEED this protection, and you should obtain it at once. THINK OF YOURSELF—YOUR LOVED ONES—YOUR CHILDREN—WIFE—MOTHER—FATHER—HUSBAND—BROTHER—SISTER. Have you provided for their future? What would happen? THINK IT OVER. I am not an alarmist, by any means—far from it—only attempting to drive home true facts. In calling your attention, reader, to this matter, you will thank me. If you have as yet failed to learn particulars of this wonderful policy, do so TODAY—not tomorrow—but TODAY. Don't let today's opportunities be tomorrow's regret.

For these and other reasons, although frequent reference has been made to the psychology of salesmanship, there cannot be said to exist any considerable body of facts, principles, or methods that differ from the established laws, results, and technique of the psychology of advertising. There is, indeed, reason to believe that the principles of successful salesmanship are no different from those underlying the successful advertisement, sales letter, or window display, although their operation in any given instance is obviously much more obscure and complex.

PSYCHOLOGICAL PRINCIPLES IN SELLING

The applicability of psychological principles to the process of selling has been ably demonstrated by Strong (*598*). The salesman need no longer look upon the act of selling as a single event He can analyze the process into various elements, steps or stages, such as preparation, approach, presentation, argument, and closing the deal. And in so far as psychological measurement is able to specify the relative strength or persuasiveness of various sales points or bases of appeal, he may utilize the results of such methods. For the most part, however, as matters now stand, the salesman can best profit from psychology by familiarizing himself in an expert way with the original and acquired tendencies of human beings; the mechanisms of conduct, thought, and feeling; the range of individual differences in interests, values, motives, and temperaments; the general lore and doctrine of expression, emotion, belief, and reflection; and especially with the laws of cogent reasoning, the fallacies of argument, and the promptings underlying such factors as suggestion, resistance, conflict, and decision. To control human behavior, one must understand it.

In so far as the personality of the salesman enters into the sales function, a new set of psychological problems arise that contribute to success in selling. These problems have to do with the characteristics of the salesman: such factors as physique, health, temperament, age, and manner of dress may be found to be important factors in the use of persuasion, suggestion, and argument. An interesting chapter in applied psychology will have to do with the diagnosis, by the various means of mental measurement, of the personal traits that combine to form the successful salesman. It will have to do with the discovery to what degree such particular qualities or aptitudes are native traits and to what degree they may be learned. It will have to do further with the conditions of practice and instruction through which the desired characteristics may be most economically and effectively communicated to those who will want to use them.

LABORATORY STUDIES OF SELLING

Psychologists are beginning to meet the challenge that the field of salesmanship offers. Psychological techniques of analysis and measurement are coming to be applied to the sales situation. Phillips (*493*) instructed his students to make shopping excursions and to record various aspects of the sales process, noting particularly their impressions of the salesman's greeting, his manner of dress, his promptness, and his knowledge of his stock. Waters (*679*) selected a group of successful and a group of unsuccessful merchants and had them evaluated by means of a questionnaire for a great variety of personality and other qualities. Certain characteristics were found to differentiate the two groups, although not sharply. Some of them were interest in the customers, honesty, desire to be accommodating, and the tendency to give uniform treatment to all customers. McKinney (*418*) and Mitchell and Burtt (*433*) have made somewhat similar measurements in a controlled laboratory setting. The latter compared various sales techniques by having a trained experimenter go through standardized sales using the following devices:

Demonstration versus a description of the commodity.
Presentation of facts versus "human-nature appeal."
Using a breezy or a dignified manner
Using a domineering or friendly manner.

The sales talks were evaluated by a group of forty student observers, who used systematic rating scales for interest, feeling, confidence, and persuasiveness. Demonstration was rated higher than description, facts higher than emotional appeal, and a friendly attitude higher than a domineering attitude. There was no clear-cut difference in the relative status of a breezy or dignified manner.

These are only small beginnings but they prove the feasibility of measurement in this field. The application of the newest techniques and scales for the measurement of attitudes of all sorts will undoubtedly bring fruitful results here as they are already doing in other spheres of human behavior.

27

Advertising and Selling by Radio

The radio constitutes a medium for the marketing of commodities that differs both from printed advertising and from direct selling, yet it has some of the characteristics of each. In more than one respect it appears to lie between the other two. It employs the human voice and appeals to the ear as personal selling does. At the same time it necessarily directs its messages to a mass audience as printed advertising does. In comparison with printed advertising it lacks whatever advantages the former has in its appeal to the eye in light and color, but it gains whatever advantages come from the appeal of human speech and music. It resembles printed advertising in the fact that the potential customer can take it or leave it—he can close the magazine and he can shut off the radio; he can turn his attention to something else while the radio advertiser speaks, and he can ignore the advertisement that shares the page with the news story.

PSYCHOLOGICAL PROBLEMS IN RADIO ADVERTISING

A host of psychological problems that have been investigated in laboratories more or less sporadically for many years have suddenly acquired a strong practical significance with the advent of the radio. Which is a more effective medium of experience, the eye or the ear? Are things seen or heard remembered better? Which is the more convincing and persuading, a visual message or an auditory message? Which has the greater span of comprehension, the eye, or the ear? Are some things learned better through hearing them and others through seeing them? Are there important differential effects of seeing and hearing upon the processes of recall and recognition? The relative merits of the printed page and of the radio as the vehicles of selling rest in part upon the answers to such questions as these.

Equally numerous and equally important are the psychological ques-

tions that arise within the field of radio broadcasting itself. Some of these are old laboratory problems and some of them are new and unique. What proportion of program time can be advantageously devoted to advertising? That question resembles those asked about printed advertising and investigated by Strong (*589*), Franzen (*181*), and others, namely, "What is the best proportion of advertising to reading matter in a magazine?" and "Is there a saturation point which it is inefficient to exceed?" Thorough research upon this problem might have forestalled the drastic legal regulations that determine the time that may be allotted to advertising in any radio program.

How can the advertising message be most appropriately presented? This, too, resembles a question asked concerning printed advertising, namely, whether it is better to segregate all advertising or present it "next to reading matter" (*292*), and whether the advertisement should be distinctive in appearance or made to simulate news items or literary content. Methods of presentation analogous to each of these are employed in radio. The law requires that printed advertisements be labeled as such when there is likelihood of confusion. Can the radio forestall, through research, the need of such protection for the public? What are the listening habits and listening preferences of people, as to time of day, length of program, real or "canned" programs, serious or light programs, music or drama, the serial story or the complete story program? What are the differences in these respects between men and women, old and young, well-to-do and poor, well-educated and poorly educated, residents of the North, East, South and West, urban and rural? These are merely a few samples of the fascinating problems the radio brings with it and that the psychologist can help to solve.

RADIO RESEARCH

Active search for psychological problems and research upon such problems is in progress by research psychologists on the staffs of broadcasting stations, by psychologists bearing the status of consultants, by specific research organizations,* and by numerous individuals in university laboratories. A considerable body of evidence has already accumulated from these sources. *The Psychology of Radio* by Cantril and Allport (*83*) and *Radio and the Printed Page* by Lazarsfeld (*369*) give a rapid over-all view of what is being done. Two special numbers of the *Journal of Applied Psychology* have been devoted to radio research (*368*) (*370*). Their editor assembled contributions of many individuals from various psychological laboratories, besides list-

* For example, the Office of Radio Research, Columbia University, New York City, P. F. Lazarsfeld, Director.

ing the research in progress at six colleges and universities. There is, indeed, an imposing array of research in progress, and of investigators working in the field of radio, in sharp contrast with the state of affairs in the earlier days of printed advertising.

VISUAL AND AUDITORY EXPERIENCE

The early studies of the relationship between the visual and auditory channels of experience were inspired primarily by the school situation and were intended to decide the relative merits of visual and auditory instruction. Hollingworth (*275,* 63-76), after a survey of this material, concludes that the evidence to be adduced from it is just about evenly divided concerning the relative effectiveness of the two modes of presentation. The conflicting data are due to the immense number of uncontrolled variables that affect the results. More recent studies made with an interest in radio have employed better techniques, though some of them still leave variables unaccounted for.

Elliott (*156*) set up a laboratory experiment to measure memory for advertisements of everyday commodities after they had been projected on a screen, spoken over a public-address system, or projected and spoken simultaneously. The test was administered to 143 subjects ostensibly as a classification test, which carried no implication of a subsequent memory test; hence whatever memory was tested would be of the "incidental" sort. Recall and recognition were measured immediately after the advertisements had been presented. Elliott found the combined modes of presentation most effective, and the auditory better than the visual. He offered the following "physiological" explanation for the advantage of the auditory mode (*156,* 48).

> [It] seems to lie in the fact that sound is non-directional in character In vision, an object must be fixated directly to enable a full and detailed reception. Acuity is greatest in foveal or direct vision Any deviation toward peripheral or indirect vision brings an indistinct picture; a deviation of 90 degrees eliminates the object of vision almost altogether In audition, however, turning the head as much as 90 degrees from the direction of the sound makes little difference in reception; sound is largely non-directional. Sound has this physiological advantage over sight.

COMPREHENSION OF THE RADIO MESSAGE

Carver (*91*) went beyond the work of Elliott in seeking the differential effect, upon visual and auditory presentation, of difficulty and kind of material presented, of the cultural level of the subjects, and of the particular functions tested.

He found, as might have been anticipated, that one cannot expect to draw a final conclusion that either the visual or the auditory mode of presentation is the more effective. Both reactions are highly sensitive to a variety of variables. He did find that hearing is more effective for simpler material, whereas the advantage is reduced as the material becomes more difficult until a point is reached where vision has a distinct advantage. Moreover, one hears familiar and meaningful material more effectively than one sees it, but when the material becomes new and strange vision has an advantage.

Carver confirms Elliott in finding memory, as measured by recognition and recall, better for heard than for seen material. But for comprehension and critical discrimination vision has the advantage. His data show, finally, that the higher the cultural level of the listener the greater is the advantage of the auditory experience. He finds justification for his conclusions in an analysis of the reading and listening function (*91*, 178-179).

In the *reading* situation, printed words, although spatially separated, are experienced more as related items in larger groupings than as isolated units—while reading one is also able to fit a word into the immediate context of words which *follow* it as well as those which have just preceded it, a factor of particular importance in the comprehension of difficult material In short, the reader to a large extent determines the range and tempo of his own perceptual experience; varying his speed, grouping words and phrases and studying contexts, he extracts from the visual-stimulus-situation as much meaning as he possibly can.

In the listening situation, on the other hand, words are separated in time and must necessarily be experienced more as isolated units.—The listener does not make his own groupings; they are made for him. In addition, the listener has an opportunity to fit a word or group of words into the context only in so far as he is able to remember the previous words. In ordinary discourse this process prevents no difficulties, but it becomes difficult when the words and context lose their familiarity.

It would appear that, in so far as the results of Elliott and Carver for remembering and comprehending are concerned, the radio would be entirely adequate for advertising purposes. For the message that the advertiser aims to deliver should be neither so new nor so strange as to overtax the listening powers of comprehension and memory of his audience. Still, the ultimate purpose of the advertiser is not limited to creating understanding and recollection, but it is rather to persuade, to engender belief, and to fix attitudes or change them.

PERSUASION VIA THE RADIO

Wilke (*704*) attacked the problem of the relative persuasiveness of a message when it is read, when it is spoken directly to the listeners, and

when it is transmitted over the radio. Although he was interested in the broader question of propaganda, his results have a bearing upon the effectiveness of an advertising message when delivered in these three ways. He set up an experiment in which the previous opinions of his subjects were known, and in which the same message could be delivered in the three ways mentioned above. Precautions were taken to control disturbing variables. In order that the results might not be attributed exclusively to the kind of propaganda material employed, four experiments were run, similar except for the variable content of the message which was about war, economics, birth control, or religion. The attitudes of his 341 subjects were measured by means of scales especiallv constructed for the purpose. Tests were given before and

TABLE 62

RELATIVE EFFECTIVENESS OF ADVERTISING MEDIA *

Percentage of Dealers Reporting Each Medium Most Effective

	Toilet Goods		*Groceries*		*Gasolines*	
	1933	1934	1933	1934	1933	1934
Radio	65 0	70 3	58 3	62 3	69.4	63 2
Magazines	6 9	7 1	6 8	8 1	4 8	7.9
Newspapers	24.6	20 3	31 3	27 2	14 5	14.1
Billboards	0 6	1.0	1.3	2 0	6 7	12.8

* From H. C Link and P. Corby, "Studies in Radio Effectiveness by the Psychological Corporation," *J. of Appl. Psychol.*, 1940, *24*, 753.

after exposure to the propaganda message, and any changes in attitude from the first test to the second were attributed to the effects of the intervening message. He found that whatever the measure of change that he used and whatever the nature of the message, the personal delivery was the most effective in changing attitudes. Next to that stood the message delivered by the public-address system (equivalent to radio), and the printed message was least effective of all.

The several typical investigations that have been described, resting upon a large collection of earlier work, suggest that, within the range of communication that advertising needs to employ, the radio suffers no particular handicap in comparison with the printed advertisement, so far as memory, comprehension, and persuasion are concerned. When serious, new, and difficult matter is to be grasped, reading has some advantage over hearing, although the best results frequently come when either one is reinforced by the other (*369*, 133-182). Whatever actual differences exist in practice between radio and printed advertis-

ing will not result from differences in the basic psychological functions involved in them, but from how efficiently they are exploited. Far weightier factors are the questions where the consumer can get what he wants, where he can get it when he wants it, and how palatably it is offered to him.

A kind of opinion poll was conducted by the Psychological Corporation (*381*) among dealers in toilet goods, groceries, and gasolines inquiring as to the relative effectiveness of radio, newspapers, magazines, and billboards in selling their goods. The survey was made first in 1933 on 2,720 dealers and was repeated in 1934 on 2,618 dealers. Table 62 gives a condensed summary of the results for the two years. The data, which are in terms of the percentage of dealers rating a given medium most effective, place radio first for the three commodities investigated.

WHAT MAKES A RADIO MESSAGE EFFECTIVE?

Psychological research has rightly been directed toward discovering what makes a radio offering good and what makes one radio advertising campaign better than another. There is a wealth of research material available that bears upon such questions as the optimal length of an oral message, the effect of repeating the message, the effect of various intervals between repetitions, the dependence of comprehension upon length of sentence, and the influence of various methods of presentation upon conviction. In fact, the whole body of knowledge concerning effective speaking could well be combed for pertinent clues. The study of Jersild (*323*) will illustrate a psychological attack upon a few of these questions and will demonstrate what could be done by way of radio if adequate facilities were available. A total of 253 persons in ten groups were subjected to a lecture containing a series of predetermined ideas. The manner of presentation of these ideas varied among the groups as to their temporal position, emphasis, number of times repeated, interval between repetitions, speed of articulation, and pauses. A recall test for the seventy ideas in the lecture followed shortly after the presentation. A well-conceived series of controls enabled Jersild to attribute the differences in the ideas recalled to the variables that he had introduced. Some of his results which are applicable to the radio setting are reproduced in Table 63. The data are expressed in terms of percentages, 100 per cent being the normal unemphasized statement. The relative value of the various devices may be read directly from the table. Thus repeating a statement five times throughout the lecture increases the recall value nearly two and a half times. Making a statement twice in different parts of the lecture instead of once raises the recall value by 69 per cent, but repeating a

statement immediately raises the recall value only 22 per cent. Slowing the rate of delivery reduces effectiveness by 18 per cent.

The applied psychologist's major contribution to radio research is not to be found in the application of information already at hand, but rather in the devising of appropriate new techniques for measurement in radio. Lazarsfeld (*370*) emphasizes this point when, in writing about radio research, he defines applied psychology as the "sum total of techniques used by psychologists when they are called upon to collaborate

TABLE 63

INFLUENCE OF TECHNIQUE OF DELIVERY UPON EFFECTIVENESS OF A LECTURE *

	Recall Value in Per Cent
Normal statements unemphasized and unrepeated	100
Statement repeated five times, distributed	244
Statement repeated four times, distributed	234
Statement repeated three times, distributed	211
Statement repeated two times, distributed	169
Statement repeated two times in succession	122
Statement delivered with verbal emphasis	167
Statement delivered with gestures	120
Statement delivered with loud voice	123
Statement delivered slowly	82
Statement delivered following pause	143
Statement given first place	192
Statement given second place	163
Statement given third place	133
Statement given last place	139
Statement given second from last place	126
Statement given third from last place	121

* Adapted from A. T. Jersild, "Modes of Emphasis in Public Speaking," *J. Appl Psychol.*, 1928, *12*, 615.

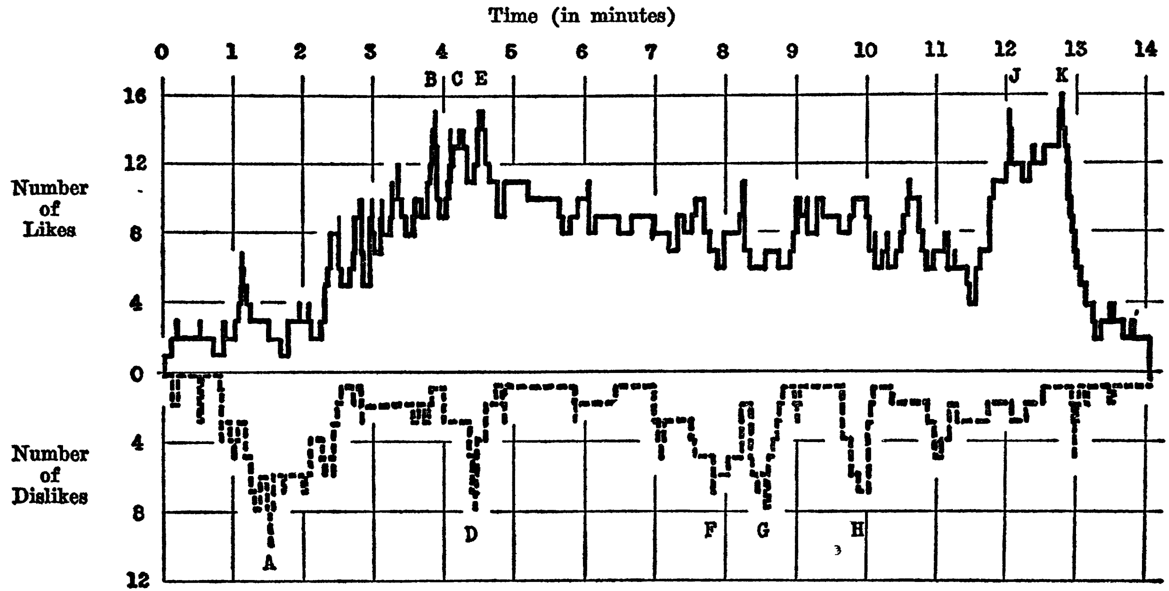
with agencies empowered to perform specific social functions." He describes in general terms three kinds of measurement that are called for. They are (1) To discover why and in what respects certain programs that are known by their popularity to be successful are successful, and to discover why those known to be poor are poor; (2) to find ways of measuring the degree of success or failure of a program in terms of size of audience, changes of attitude in the audience, or goods purchased by the audience; and (3) to devise techniques for measuring the probable degree of success of a program before it goes on the air.

PSYCHOLOGICAL TECHNIQUES FOR MEASUREMENT IN RADIO

A survey of the literature in radio research shows that psychologists are actively at work on techniques of measurement. One finds an index

FIGURE 107

Measuring Attitudes Toward Radio Programs with the "Radio Analyzer" *



* From J. N. Peterman, "The Program Analyzer," *J Appl Psychol*, 1940, *24*, 733.

of "radio-mindedness" (*472*) for measuring the susceptibility to radio in the various classifications of the population. He will find "indices of attitude" toward radio advertising, and comparisons of one index with another for their statistical characteristics (*539*). Methods are described for gauging the entertainment value of a radio program (*384*) and for isolating the appeal of some special feature of a radio program (*116*). The technique employed by Coutant for the latter calls for the use of a "test audience" which listens to play-backs from recordings of programs. Various aspects of a program were rated by Coutant's subjects on a four-point scale: uninteresting, fair, good, and excellent. The features gauged were the voice, the personality, and the message of the announcer; the musical selections and the quality of the orchestra; the leading man and the leading woman; the story; the group songs and the voices. Coutant was able to conclude concerning this one program that the talent was excellent, although the material with which they had to work was very poor. The remedy would be obvious to a sponsor.

Two difficulties appear in the use of this technique, one from the inability to distinguish in retrospect the effects of the various features and the other from a kind of halo effect in which a general impression colors reactions to specific aspects of a program (*570*). A refinement of technique to overcome these obstacles, called the "program analyzer," has been devised by Lazarsfeld and Stanton and described by Peterman (*492*). It enables a judge to record his likes or dislikes for any item in the program by pressing either one of two keys that record on an ink-polygraph, or to indicate indifference by pressing neither key. A time line in seconds on the polygraph makes it possible to associate the reaction with the proper item, since the program is produced from an accurately timed electrical transcription. The parts liked or disliked by each subject are later played back with the request for comments. One analyzer has been constructed to accommodate eleven subjects simultaneously. A composite record from fifty-two subjects is reproduced in Figure 107, where the vertical scale above zero represents the number of persons expressing likes, and below zero the number expressing dislikes. The horizontal time line is in units of a minute. A casual inspection of the chart shows a number of interesting facts and suggests that examination of the record of each individual will reveal many more. It indicates that the analyzer is a sensitive instrument in that it records a wide range of likes and dislikes. It discloses a tendency for certain parts of a program to be rather generally liked or disliked, although it suggests at the same time that sections of an audience can differ sharply in what they like or dislike.

MEASURING THE ADVERTISING VALUE OF A RADIO PROGRAM

The methods for determining the actual sales resulting from radio advertising resemble those that have long been employed for printed advertising, although great ingenuity is being exercised in modifying them for specific purposes. Questionnaires, opinion polls, and "Brand Barometers" are supplemented on occasion by an actual inspection of pantry shelves in order to make a census of the particular brands they contain. Stanton (*579*) gives an inkling of a testing procedure that seems to the casual observer to be extremely elaborate and costly but which is apparently justified by the information it reveals (*579*, 667)

> Field investigators visited stores, made careful checks upon dealers' inventories, peered over the dealer's shoulder at his purchase records and his bills of lading; they telephoned families, interviewed them personally and inventoried their pantries.

On another occasion Stanton (*579*, 669) reports

> A coincidental telephone survey of 4,131 families was made *while the program was actually on the air* to isolate two groups: those who were listening and those who were not. This procedure enabled the investigators to return to these same families and conduct personal, face-to-face interviews with the families which were "known listeners" to the program and with those who were not listening.... Then the interviewers asked permission to enter the pantry to observe for themselves what brand of the product was on the shelves. Thus when the investigators departed, they knew whether each respondent listened to the program and they knew further what brand of the product each family actually had on hand.

These various investigations have been described not for the purpose of reporting results but solely to give some notion of the psychological problems involved in radio advertising and of the techniques that are being devised to solve them. The field is a new one where conditions are constantly changing and where there is urgent need for able and well-trained personnel to prepare for service in it.

28

The Causes of Criminal Behavior

The preceding chapters have all been concerned with the process of adjusting individuals to living. Interest now shifts to the problem of readjustment or the correction of maladjustments. There always have been and probably always will be persons whose behavior does not conform to standards which hold for their society. They differ more than the allowable amount from the general run of people. If the deviation is in the direction of genius their value in an enlightened society will be recognized and special privileges and rewards will be granted to them. If, however, the deviation is of such a nature as to jeopardize the welfare or the perpetuation of the society, then the individual is called maladjusted and something must be done about him.

Both the concept of maladjustment and of what should be done about it has varied much from one social group to another and from period to period within the same social group. What is considered a crime in one society is not a crime in another, and what is considered a crime in a prosperous period in a given society may not be a crime in a period of depression in that society (*549*). Moreover, what is looked upon as a *crime* in one epoch may in a more enlightened epoch be treated as a *disease.*

As to variations in the conception of what should be done about "dangerous" deviations from the norm, little need be said. Not only are there striking contrasts in this respect between primitive and enlightened societies, but even among the states of the United States there are surprisingly great differences, both in the treatment of crime and in the treatment of disease, particularly mental disease (*359*). An inquiry into the contributions which the applied psychologist has made and can make in the prevention and correction of maladjustments will have to take note of the fluid nature of the concepts of maladjustments and of how to deal with them. Crime, which is one form of maladjustment of great social concern, will be discussed in this and the three succeeding chapters.

THE LAW AND THE CONCEPT OF INDIVIDUALITY

The application of psychology to practical human problems has everywhere forced attention, as we have seen, upon the individual, so that his characteristics are made to determine procedures in which he is involved. The law is no exception. A shift of emphasis in which the individual becomes the unit of action implies a thoroughgoing knowledge of the nature of human conduct and the factors on which it depends. The availability of this knowledge and the increasing readiness to see its applicability to the law have made important and far-reaching changes in legal technique. The recognition of profound differences between the child and the adult has led to the organization of children's courts, where the whole machinery of the law is better adapted to the handling of their problems. Cognizance has been taken, likewise, of the differences between men and women offenders, between first offenders and repeaters. Distinction has been drawn between the various kinds of criminal acts and the treatment they should receive. The most obvious innovations based upon the psychology of the individual are the indeterminate sentence, parole, and the suspended sentence. By the proper use of these devices, the treatment may be planned according to the nature of the individual case rather than according to the crime committed.

The psychology of the individual will not be limited in its application merely to the individual offender. It should extend to all persons involved in the processes of the law. Where the jury system is in force, the psychology of the juryman offers some very interesting problems. What is the capacity of the juryman to grasp the details of a case as they are presented? What is his ability to organize and weigh the details in arriving at an opinion? What is the influence of one dominating juryman upon the judgment of the others? These and many other pertinent questions might be raised. What can a witness of an event be expected to have seen or heard, and how much of what he has seen and heard can he be expected to remember in the court room? What is the effect of fear, anger, or fright upon the value of his report of events? The judge, too, would be found, upon investigation, to have an individuality that reflects itself in his judgments and makes them different from those of every other judge.

The facts of individuality have their greatest application in the determination of the conditions leading to crime and in the discovery of the point where the responsibility for crime should rest. All the facts of modern psychology lead to the conclusion that behavior at any moment is the product of a great number of contributing circumstances both within and without the individual, and that in no sense is he

entirely free to choose his actions. From the psychological point of view, criminal behavior does not differ from normal behavior and is, therefore, subject to the same laws of cause and effect. In order to prevent any given reaction, control must be exercised over the causal factors. Likewise, in order to modify any form of behavior, as in the reformation of a criminal, the same facts of cause and effect must be recognized, and the process of reorganizing habits of action and habits of thought must be carried through as in any form of learning. The questions of responsibility for crime and of the punishment of the responsible person are clearly secondary in importance to the question of the conditions of criminal action, and the exercise of such control and treatment of the individual that further criminal action may be prevented in those who are already offenders, and that original offenses may be forestalled in all other cases.

THE DETERMINANTS OF BEHAVIOR

Every human action, except those which are clearly automatic, can be analyzed into a number of factors, and its cause into a number of partial causes. There is a motive or impulse behind every act, which may, in itself, be weak or strong. The impulse to eat, immediately after a big dinner, is reduced almost to zero strength, whereas the same impulse, after two days of fasting, may assume tremendous force. The nature of these impulses and their variety have been discussed in Chapter 2. Such impulses do not always lead to overt action because they are subject to restraint or inhibition. A man may, for example, have a strong impulse to eat, but check it and refrain from eating because it is not his regular meal-time, because it is against his doctor's orders, because it is a period for religious fasting, or because he does not have the money to purchase food. Finally, he may not eat because his immediate environment does not afford the edible substances necessary for the reaction.

Superimposed upon these tendencies is the capacity to foresee the consequences to which satisfaction of the impulse will lead. To return to the food-taking illustration, the individual who is instructed by his physician not to partake of certain foods may not be able to see far enough into the future to realize the consequences for his health of indulging his impulse. The composite of circumstances, upon which the choice of any course of action depends, is seen to include the strength of the impulse to act, the strength of the inhibiting or facilitating influences within the individual, the intelligence and information requisite to knowledge of consequences, and the environmental factors either furthering or hindering the reaction. Each of these items is merely the

name for a complex of separate and distinct factors. Any particular act may be the result of a number of combinations of circumstances. Thus the act of stealing a loaf of bread may follow from (1) an overpowering impulse caused by hunger, (2) a moderate impulse uninhibited by any social or ethical considerations, (3) a moderate impulse with moderate restraint, but an environmental situation inviting theft. Although, objectively, the act of theft is the same, from the point of view of the individual and his treatment each one of these cases is entirely different from every other.

This psychological attitude toward criminal behavior is in strong contrast to the legal point of view, according to which every individual is responsible for his behavior, if he knows the nature and quality of his acts. Furthermore, he is said to know the nature and quality of his acts if he cannot be proven insane. A growing recognition of the weakness of such an interpretation is evident in the recourse to the pleas of temporary insanity, "brainstorm," absence of moral responsibility, and in very rare cases to the plea of feeble-mindedness. A change to the psychological point of view does not imply a sentimental coddling of the offender and a disregard of the social defense. The preventive measures which rest upon a thorough psychological foundation and which call for treatment of the individual according to his symptoms will provide the maximal social defense. For there will be no attempt to reform those who cannot be reformed, or to return to a social environment those who lack the recognized prerequisites for normal social behavior.

HEREDITARY AND ENVIRONMENTAL DETERMINERS OF CRIME

The foregoing analysis of the conditions of behavior would suggest that the determiners of crime might be sought both in the hereditary make-up of the individual and in the environmental influences that surround him. So the capacity to foresee, broadly interpreted as intelligence, and the intensity of certain impulses to action could be native, whereas a condition of poverty in which there was the absence of food and no money to acquire it could be called environmental. Emphasis upon one or the other of these sets of conditions has led to a constitutional interpretation of crime on the one hand and a social interpretation on the other. The earlier history of research on crime was largely concerned with the support of either one or the other of these systematic points of view. Lombroso (*383*) championed the concept of a born criminal type and listed both its anatomical and mental indicators such as low and receding forehead and large ears, dull sensitivities, and vio-

lent temper. Tarde (*604*), on the other hand, put up a strong case against the hereditary criminal type and for the social causation of crime, making imitation the most potent factor in the creation of a criminal career.

More recently Rosanoff, Handy, and Rosanoff (*531*) supported the hereditary concept through the study of criminal careers of twins estimated as identical and non-identical. When the twins are rated as identical, the chances of both members of the pair being criminal are many times greater than when the twins are rated as non-identical. The validity of these figures has been questioned by Reckless (*513*, 186-188) on general grounds, so that what seemed at first sight like crucial evidence for a germinal factor in crime determination, remains crucial no longer

INTELLIGENCE LEVEL AND CRIMINAL BEHAVIOR

The psychologist has had his greatest interest in the part that native intelligence plays in the picture of crime. The demonstration of intelligence as the major determining factor would greatly strengthen the case for heredity. A judicious weighing of the vast body of evidence derived from the intelligence measurement of criminals and delinquents leaves the question unsettled and open. There is the evidence derived from the study of the criminal histories of certain notorious families, such as the Jukes (*148*), the Kallikaks (*218*), and the Nams (*163*), all of which focused attention upon feeble-mindedness as a major factor in crime. The conclusions derived from these genealogies have been criticized on many grounds, but most forcibly because of the errors inherent in the estimation and measurement of degree of intelligence in the various generations.

The statistical treatment of data obtained from prisons, reformatories, houses of detention, and courts furthered the belief in the close relation between feeble-mindedness and crime (*217*). None of the evidence has gone unchallenged and the challenge has been supported by contrary evidence. Some of this challenge has come from the report of Murchison (*446*) upon the intelligence of inmates of five state penitentiaries whom he tested (with the Army Alpha intelligence examination) and compared with the adult male white population comprising the draft during the first World War. A sample of his data is reproduced in Table 64. The first column shows the familiar letter grades according to which intelligence was classified in the army; the second column gives the percentage of criminal cases falling with each letter grade; the third column gives the same for the total white draft in the United States; and the fourth column gives the same for that portion of the

draft drawn from the five states where the penitentiary cases were studied. After making allowances for certain factors of selection, the author concludes that the criminals examined by him have an intellectual status equivalent to that of the normal white population.

It may be admitted that the figures obtained from reform institutions and women's and children's courts tend to exaggerate the importance of mental deficiency as a causative factor, if for no other reason than that one finds there only those delinquents whose low intelligence did not enable them to escape or cover up their delinquency.

TABLE 64

INTELLIGENCE OF CRIMINALS FOUND IN PENITENTIARIES *

	Percentage of Criminal Cases	*Percentage of White Draft*	*Percentage of White Draft in the Five States*
A	5.3	5 1	5 8
B	11 4	9 7	11 0
C +	22 8	18 8	19.4
C	28 5	28 7	29 3
C −	17 8	21 4	20 0
D	6 9	8 8	7 9
E	7 5	7 5	6 3

* From C. Murchison, *Criminal Intelligence* (Worcester, Mass , Clark University, 1926), p 49

It is probable also that these institutions receive cases that are guilty of minor crimes such as low-grade intellects are likely to commit. On the other hand, the penitentiary cases comprise a select group who are likely to fall within the upper levels of the criminal population. That the intelligence does vary considerably with the type of crime is clear from the data shown in Table 65 which are also taken from Murchison. The criminals are here divided into seven classes, and the intelligence of each class is expressed in letter grades, just as in Table 64. More than half of the individuals committing crimes of fraud are of superior intelligence, whereas about half of the sex offenders are of inferior intelligence.

The survey by Tulchin (*653*) of more than 10,000 cases from penitentiaries and reformatories in Illinois confirms the main conclusions of Murchison. Tulchin took elaborate precautions in matching the criminal group with the draft population of Illinois, which was to represent the normal population. The tests and test conditions were the same, and consideration was given to the influence of such factors as nativity, time in the United States if foreign born, race, type of crime committed, age, and social and economic status. Some of his

TABLE 65

DISTRIBUTION OF INTELLIGENCE ACCORDING TO TYPE OF CRIME *

	Normal Five States	*Fraud*	*Force*	*Thieving*	*Statutory*	*Physical Injury*	*Dereliction*	*Sex*
A ..	5 8	12 3	4 8	4 3	3.2	4 8	4.2	4 0
B . .	11 0	15 8	11 9	11 3	11 2	8 7	12 6	8.4
C +	19 4	24.8	23 8	25.1	20 3	21 5	18 5	13 9
C	29 3	25 1	29 6	27 6	34 2	28 3	21 8	26 6
C −	20 0	11 4	18 6	17 2	17 1	19 6	20 3	22 6
D	7 9	8 2	5 7	7 3	7 5	7 0	7 6	10 7
E	6 3	2.4	6 3	7 3	6 4	10 3	15.2	14 3
No. cases . .	..	331	1,542	992	187	521	119	253

* From C Murchison, *Criminal Intelligence* (Worcester, Mass, Clark University, 1926), p. 62.

data are summarized in Table 66. These two studies, which could be supplemented by many others, should finally dispose of the belief that low intelligence is a major determining factor in crime, however important it may be in conjunction with other variables.

TABLE 66

SUPERIOR AND INFERIOR INTELLIGENCE AMONG CRIMINALS *

	Percentage	
	Inferior	Superior
Army sample	25 9	10.6
Penitentiary cases . ..	23 4	11 8
Reformatory cases	15 0	13 0

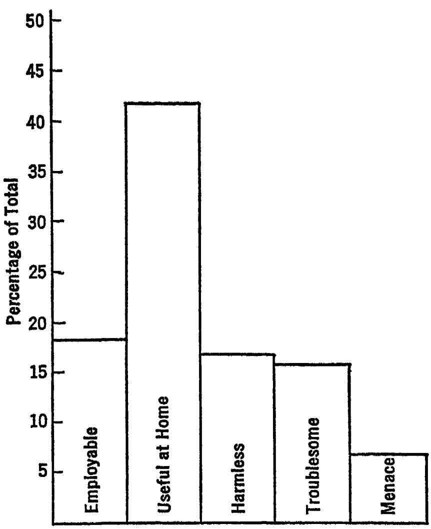
* Adapted from S H Tulchin, *Intelligence and Crime* (Chicago, Ill, University of Chicago Press, 1939), p 153

Three facts seem to have been demonstrated. First, not all crime is owing to mental deficiency, for in practically every institution there are criminals who are not mentally defective. Hence other factors contributing to criminal behavior must be diligently sought. Second, not all defectives are delinquent, for there are many of them living sheltered lives in a simple environment who do not necessarily become delinquent. The findings of the New York State Commission for Mental Defectives, reported by Ecob (*155*), bear out this statement. A survey of the state shows that about ½ of 1 per cent of the total population is defective. An examination of these cases gives a picture which should be studied in connection with the reports of deficiency in institutions

for delinquent cases. A sampling of 412 cases referred to the state clinics was classified as shown in Figure 108. This classification is more or less subjective but represents the opinion of each case gleaned from consultation with the family and teachers, and from a mental examination. The "employable" group includes those that were employed at the time of the examination or had been previously employed at a wage ranging from $1.25 to $25 per week. The group marked "useful at home" includes those that are able to do such work as care for children, general housework, and odd jobs. The "harmless" group includes stable low-grade individuals that have about the same status in the family as young normal children. The "troublesome" group comprises unstable cases, many having delinquent tendencies. This group includes also those who are troublesome because of the excessive amount of physical care that they require. The "menace" group includes cases "showing definite antisocial behavior and also those with poor supervision, unable to protect themselves from unscrupulous persons." The "troublesome" group and the "menace" group together comprise only 23 per cent of the defectives; nearly as large a percentage is found to be employable. In a similar survey of 415 lower-grade cases (75 per cent being imbecile or below) the classification was as follows:

FIGURE 108

Status of Mental Defectives in the State of New York *



* From K G Ecob, "New York State's Accomplishments and Immediate Aims in Extra Institutional Care of Mental Defectives," *Amer Assoc Study Feeble-Minded, Proc 48th Ann Session*, 1924, 27

	Per Cent
Employable	18
Useful at home	11
Harmless	26
Troublesome	37
Menace	8

Even here, only 45 per cent of the cases are troublesome or worse, a good proportion of whom are so classified because their low grade makes them a physical burden.

The third fact disclosed by these studies is that defectives may be prevented from becoming delinquents, at least in a majority of the cases, by provision of the proper care and supervision. Those cases that show antisocial tendencies can be cared for best in institutions adapted to the purpose. The other cases can be sufficiently supervised without institutional care. What seems to be most essential from the point of view of crime prevention is the discovery of mental defectives in their early years, a follow-up of their progress, and a diagnosis at their entrance into adulthood as to the class into which they fall and the treatment that they should receive. By such means they will receive attention before, rather than after, they have become criminals. As the discovery of intellectual status is most readily made in connection with educational progress, the task of classification and supervision of the careers of these cases might well become a part of the system of public instruction. Such supervision should include all children, both those in school and those who, on account of defect or for any other reason, do not attend school. A program of this sort might well be the outcome of the work already begun by the agencies dealing with defectives. It becomes increasingly feasible with the wider and wider use of the intelligence examination as a part of the regular school program.

IMPULSE AND CRIME

Among the factors determining behavior is the powerful impulse to act which overrides all resistance. These impulses may lead to good or ill, but wherever there are unchecked impulses of this type, there is at least the likelihood of criminal behavior. Perhaps the clearest and most notorious cases of this sort are to be found among the kleptomaniacs and the pyromaniacs. The former seem to have an uncontrollable impulse to take things. Usually what is taken is not needed. This behavior occurs frequently in persons whose whole environment and whose associations would tend to inhibit such actions. Likewise, the pyromaniac will set fire to things, without malice or the intent to harm, but simply because he cannot help doing so when the impulse develops. The sex offenders are frequently of this type, and their behavior resembles that of the maniac. The student of behavior recognizes these phenomena as exaggerations of normal impulses.

Closely related to these forms of impulsive behavior is that of the paranoiac who acts upon a fixed and impelling idea. If this idea happens to be that he is a very superior being, his behavior may be ridiculous and harmless, but if it happens to be an idea of persecution, he may commit murder to "protect" himself. The psychological analysis of juvenile delinquents, such as is made by Healy (*252*) and his associates,

shows the frequency of such impulsions in antisocial behavior. The onset of mental diseases often manifests itself in outbreaks of ungovernable impulses, as in dementia praecox and paresis (*215*).

The prevention of criminal acts due to ungovernable impulses presents a particularly difficult problem in some respects. In the pathological cases, the criminal act very often furnishes one of the earliest symptoms of the disease. What is needed, then, is the discovery of more sensitive methods of diagnosis than are at present available, in order that criminal acts may be forestalled. Many inexcusable crimes are constantly occurring because persons known to have ungovernable criminal impulses are allowed complete freedom, or are placed under the inadequate supervision of their families. Many are imprisoned for such acts and are released after a short term with no improvement in their condition and with full opportunity to repeat their crimes. A thorough understanding of the psychological characteristics of these persons will initiate a form of treatment that will prevent at least any but first offenses. Where the situation is complicated, as it frequently is, by mental deficiency or by deficiencies in training, prevention may be more readily secured by early discovery of these conditions and by proper supervision thereafter.

CAPACITY FOR RESTRAINT

There is an important psychological difference between behavior that results from an overpowering impulse that breaks through all resistance and behavior that results from a moderately strong impulse that meets only weak opposition or no opposition at all. The difference has been demonstrated experimentally by Crane (*119*) in his measurements of differences in the fear reactions of whites and Negroes. By the use of an ingenious technique, he measured both the withdrawal of the hand from an impending stimulus and the commotion within the muscle when the actual withdrawal movement was inhibited. He found that, whereas the fear impulse was stronger in whites than in Negroes, the overt reaction was less pronounced in whites because of their greater power of inhibition directed to the suppression of these movements. There were pronounced individual as well as racial differences disclosed. It is possible, as this experiment partially suggests, that there may be native differences in inhibitory capacities as well as in the strength of impulses. But the major influences working toward suppression of impulses come from training, under the name of custom, religion, social pressure, morale, fashion. That is, a body of mental and motor habits must be built up which will counteract the native and acquired impulses toward antisocial behavior.

The inhibitory ideas regulating our everyday conduct are numerous and varied—the fear of spending eternity in hell, the fear of the electric chair, of punishment by imprisonment, the prospect of a suit for damages, of facing arrest, of loss of position or social status, the likelihood of public ridicule, or of loss of one's own self-esteem are such deterrents. Habits of thought and action in accordance with accepted principles of morality instilled through years of training and example must not be underestimated as checks against anti-social ideas. The answer of persons so trained to suggestions of antisocial behavior would probably be, "Why, I could not think of doing such a thing!"

The fear of punishment as a deterrent of criminal and prohibited acts, and punishment as a form of treatment for offenders have played such an important part in legal procedure that discussion of it will be reserved for a special chapter on the treatment of the criminal.

ENVIRONMENTAL INFLUENCES AND CRIME

There remain for consideration those factors affecting behavior that may be grouped under the head of environment, exclusive of education and social influences which might be so designated. Innumerable environmental conditions have been made responsible for crime at various times. Healy (*251a*) found that conditions in the home were next to the most frequent causative factors in the 823 delinquents examined by him, the most frequent cause being the mental abnormalities and peculiarities of the individual. The method of correlation long ago suggested a certain relationship between amounts of crime and geographical location, climate, season of the year, and weather conditions (*136*) (*304*). High temperatures are said to increase the number of crimes against the person, because of the general irritability and emotional unrest produced by excessive heat, and also because the nature of the outdoor life that is encouraged by warm temperatures facilitates crime of that sort. On the other hand, it is said that low temperatures encourage crimes against property because of the greater need in low temperatures for food, shelter, and clothing, and the greater difficulty of getting these necessities. The long nights of winter, too, offer more opportunity for crimes against property such as theft and burglary. Such conclusions as these are supported by statistical studies of crime in different sections of the United States, in different countries, and in the same neighborhood at different seasons of the year. The weather, too, is held responsible for criminal acts in the sense that certain weather conditions are conducive to health and make possible an increase in the reserve supply of human energy. This excess of energy may, of course, be directed to some useful purpose, but, if it is not, can

lead to criminal acts. These influences are, to say the least, very indirect and cannot play more than a secondary rôle in the causation of crime.

There are, however, more tangible environmental influences that deserve consideration because they tend to reduce the power of restraint. Among these are drugs and stimulants and various agencies that possess a strong suggestive influence. It is true, perhaps, that none of these will have any great potency over the individual who is normally constituted as to intelligence, strength of impulses, and power of inhibition, but for the persons who have a "borderline" intelligence, or whose behavior determinants are delicately balanced, they may be the provocative stimuli in the direction of criminal actions. Alcohol is particularly notorious as a means of depressing the factor of control, and of freeing the individual from "hampering" inhibitions (Chapter 11). The matter becomes doubly significant when it is recalled that alcoholism is more frequent in those persons who tend to be unstable and incapable of meeting their social obligations. Even though the proportion of the population thus adversely affected is relatively small, the prevention of crime would necessitate the careful regulation of the use of alcohol. The case is even clearer in regard to opium, cocaine, and other habit-forming drugs, which are already under severe control.

The influence of suggestion is more subtle and difficult to trace. Its effects are greater upon young persons and those who, though of adult age physically, are mentally retarded (Chapter 5). Statistics gathered within recent years show that criminals are recruited from the very young portion of the population. It need not be presumed that suggestions carried by such media as the public press (*288*), magazine stories, and motion pictures (*638*) are directly responsible for the crimes of the young, but merely that such young persons with criminal interests are the ones most readily directed by the force of suggestion.

Recognition of the significance of these influences is not lacking. Newspapers of the better grade censor their items of criminal news, and present them in their correct social perspective. Those that do not do so are subject to attacks by legislative and other public bodies which call for a decrease in amount of space devoted to crime news and reduction in the size of headline by which such items shall be displayed. The general tone of motion pictures has been raised so that they are less subject than they were in the earlier days to public criticism and censorship. Much still remains to be done among certain classes of publicity devices for the protection of the highly suggestible portion of the population.

There are certain environmental influences that are difficult to classify, but which lead to the creation of the "casual" criminal. In the

discussion of intelligence defects and their relation to crime, it was pointed out that defective mentalities may not be adequate to meet competition and survive by straightforward efforts in the highly complicated social life of today. They are driven frequently to compensate for their defects by illegitimate and criminal methods. It happens, too, that individuals who have been successful in their social and human contacts for years will be unable to meet sudden and extreme emergencies in their careers. The first World War demonstrated clearly that "normal" is only a relative term, for thousands of people who adapted themselves perfectly in times of peace could not meet the changed conditions induced by war in the same straightforward fashion. "Shell shock" occurred in the trenches, whereas "war shock" appeared far from the field of battle and in all lines of work. Prolonged sickness in the home, business disasters, the lure of the "opportunity of a lifetime," and many other crises serve to strengthen impulses or to lessen the powers of inhibition and lead to irregular or reprehensible conduct. Such sporadic criminal outbreaks are difficult to prevent because in the individual case they cannot be foreseen. But, at least, precautions can be taken to guarantee that such persons are not molded into repeaters or confirmed criminals as a result of the treatment for their first offense.

CAUSATION OR CONTINGENCY

The foregoing discussion will have made it clear that there is no one cause of criminal behavior, nor any two or three causes. The most that can be expected is that there would be a complicated pattern of factors which, by summation or by mutual reinforcement, would impel to criminal action. A survey of the history of criminology has led Reckless (*513*) to conclude that the search for causes in the traditional sense has been the greatest influence retarding progress in that field. Among such assumed causes he cites "heredity, glandular dysfunction, mental deficiency, psychopathic personality traits, thwarted wishes, family disorganization, unwholesome recreation, unemployment, poverty." It is, according to him, not necessary to find causes in order to understand and control criminal behavior. All that is necessary is to determine *contingencies* between certain traits and conditions and criminal action, upon which predictions can be based. Such prediction will express the chances of a given pattern of factors being associated with crime. Reckless says (*513*, 3):

> While differential crime risks, after they have been validated for various categories of people, do not tell why persons become criminal, they do tell what persons become criminal. Instead of pointing to causality, they indicate contingency, which is a more than accidental association of visibly recorded traits

and conditions with persons who become officially recorded as offenders. Moreover, valid studies of differential crime risks should lead the way to effective preventive measures, by specifying the levels and categories of individuals in any society who are the most likely to become official offenders.

The procedure outlined by Reckless seems to be identical with that used for the prediction of vocational fitness (Chapter 12). It requires a criterion group, in this case individuals or classes of persons whose degree or kind of criminality is known, and a series of facts of behavior and attitude, however determined, whose relation or correlation with the criterion can be found. Where the correlation coefficients are large the predictive value is high, and where they are small the predictive value is slight. The characteristic of this procedure, sometimes called actuarial, is that it is statistical as contrasted with the observational or the clinical method in which relationships are discovered by inspection.

FACTORS IN DELINQUENCY

The study by Burt (*67*) (*69*) of 197 delinquent and 400 non-delinquent children will illustrate the actuarial method, in spite of the fact that he was ostensibly seeking "causal relations" and employed some of the procedures common to other methods to be described later He started with a list of items of information or conditions, and looked for their presence or absence in the delinquent and non-delinquent groups. Some of the conditions were objectively observable as "father dead," "step-father in family," or "child epileptic"; some were objectively measurable, such as degree of mental deficiency; some had to be estimated, such as defective discipline or uncongenial school environment; and some had to be inferred such as day-dreaming or emotional apathy. One hundred and seventy conditions were found to affect a child unfavorably and seventy of these were rated as a principal determinant in one or more cases. There were on the average nine or ten factors found to be associated in a delinquent child, one of which would be the major factor, whereas there were only about three in a normal child. Burt concludes that it may be either the number of factors or the peculiar pattern of them that makes the delinquency probable. Table 67 shows, for groups of factors in boys, the percentage of cases in which the major factor was in that group, also, for both sexes, the ratio of the delinquent to the normal group in the total number of factors present. Group I represents the conditions in the parents with which the child's delinquency is to be related, and comprises such matters as tuberculosis, rheumatism, syphilis, epilepsy, mental deficiency, insanity, temperamental deficiency, sexual irregularity, suicide, and alcoholism. The most significant group of factors is the emotional

(IV-B) which is a major factor nearly four times as frequently as the intellectual factor. The environmental group (II) stands next, where the conditions in the home are more frequently major than those outside the home. Intellectual and physical conditions are least frequently noted as major factors. Omitting the hereditary factors, which

TABLE 67

RELATION BETWEEN DELINQUENCY AND CONDITIONING FACTORS *

Groups of Factors	*Percentage of Time a Major Factor in Boys*	*Ratio of Delinquent to Normal in Total No. of Factors. Both Sexes*
I. Hereditary Conditions (Condition of Parents)		
A. Physical	2.4	1.6
B. Intellectual	4 0	4 3
C. Temperamental (with pathological symptoms)	11.3	2.1
D. Temperamental (with moral symptoms)	8.8	4.0
Total	26.5	
II Environmental Conditions		
A. Within the Home		
1. Poverty	3.2	1 6
2. Defective family relations	5.7	3.7
3 Defective discipline	8 9	7.0
4. Vicious home	3.2	5.7
B Outside the home	8.9	
Total	29 9	2.9
III Physical Conditions	11.2	1 8
IV. Psychological Conditions		
A Intellectual	11.4	2.5
B. Emotional		
1. General	13.0	3.5
2 Specific	10 5	5.0
3. Interests	7.3	3.7
4 Complexes	11 2	...
Total	53 4	

* Adapted from C Burt, "The Causal Factors of Juvenile Crime," *Brit J of Psychol.*, 1923, 3 (Med Sect) Pt 1, 12-27.

are duplicated in a sense in the succeeding groups, it appears that the commonest differentiating factors between the delinquent and non-delinquent groups are defective discipline, vicious conditions and defective family relations in the home, and the emotional conditions of the individual. Such factors as poverty and physical conditions are relatively infrequent.

Not all investigations give the same relative emphasis to these various factors nor in fact do all disclose the same factors. Thus, although home influences are given great relative weight by Glueck and Glueck (*216*), as they were by Burt, they turn out to be much less significant in the complex of factors revealed by Shaw and McKay (*553*). One reason for discrepancies has been pointed out both by Reckless and by Healy and Bronner to lie in the fact that what is significant for behavior will depend not so much upon the conditions that surround the individual as upon what conditions he responds to and what meaning they have for him. This finding should not surprise the psychologist as there are evidences of it on every hand in the psychology of normal people. It does, however, call for a validation of the conclusions derived by the actuarial or statistical method.

THE CASE-STUDY METHOD

The case-study method furnishes the validation and check that were considered necessary in the statements just made. It has, however, been extensively used in its own right by sociologists, anthropologists, psychiatrists, and psychologists. The method consists essentially in an intensive investigation of each case, employing the individual's own record of his experiences, interviews, questionnaires, tests, and all possible supplementary data from parents and other relatives and from schools, courts, and probation officers. It discloses factors in behavior that are not usually included in actuarial surveys—such as attitudes, fears, ambitions, and frustrations—either because their presence is not detected or because they do not lend themselves to statistical treatment. The great extent of the use of this technique in psychology is demonstrated in a survey made by Allport (*5*) under the sponsorship of the Social Science Research Council. An enlightening specific illustration of its use in the field of personality will be found in Murray's (*452*) *Explorations in Personality*. The whole process of prediction of behavior from case studies has been thoroughly and critically canvassed by Wallin (*676*), also with the support of the Social Science Research Council. The report will serve as a useful guide for the applied psychologist who wishes to employ case histories for any type of prediction, but particularly for prediction of criminal behavior. *The Jack-Roller* by Shaw (*552*), is a concrete and dramatic exemplification of what a case study may reveal about the causes and treatment of delinquency that can never be arrived at by more formal techniques which must depend very largely on statistics. In contrast to the list of factors whose association with criminal behavior was studied by Burt are the following characteristics derived from an analysis of the life record of the Jack-Roller.

They are, in the main, personality traits developed early in his life, many of which can be traced directly to influences within his home and neighborhood. His criminal career can be explained in terms of them, and his eventual readjustment to life was worked out by taking account of them. These characteristics are (*552*):

Early rise and persistence of a sense of justice
Self-pity
Hypercritical of others
Always right, never takes blame but readily blames others
Readily makes friends and as easily breaks with them
Excessive interest in getting attention
Lacks insight into his own motives and those of others
Suspicious toward others without sufficient cause
Ideas of persecution
Substitutes rationalization for insight
Builds up a rational system of explanation
Absorbed in his own ideas and plans and relatively immune to suggestion from others
Resentment of correction and resistance to direction
Tendency to escape from unpleasant situations by the method of protest
Tendency to moralize
Speed of decision and strength of reaction

The two methods of determining contingency, the actuarial and the case-study method, do more than merely supplement each other. They approach each other in form by the application of tests and measuring scales to quantify the attitude data obtained in the latter, and by the search for more fundamental factors when relationships with crime are sought in the former. The most adequate technique would be one that combined the good points of both the statistical and the personal methods. An approach to the conjunction of these two methods will be found in the study by Laune (*366*) on *Predicting Criminality* in which an elaborate attitude questionnaire was applied to a large number of prison inmates.

THE PSYCHOANALYTIC METHOD

The psychoanalytic method of discovering the conditions of criminal behavior would appear to stand in sharp contrast with the two techniques just described. The inadequacy of the statistical approach is expressed in the words of Alexander and Healy (*4*, 3-4) who have analyzed a series of criminal cases.

It is our conviction that any great reduction of crime will result neither from assuming a *laissez-faire* attitude nor by deductive speculations, nor through

superficial statistical studies (such as computing the coincidence of crime with some external and easily obtainable data), but solely by a better understanding of the psychological processes which underlie human behavior in general and crime in particular. . . Those factors which, statistically considered, are commonly regarded as major determinants in the causation of crime (such as unfavorable environmental conditions—slum districts, broken homes, alcoholism of the parents, economic uncertainty, etc) are factors which become effective only in a special setting and in combination with the reactive tendencies of certain personalities.

The inadequacy of the usual case-study method was indicated in the statement of these authors that the "bottom of the difficulty" has never been reached by way of personal, social, and psychiatric investigation and treatment. It should be noted that cases were chosen for study by Alexander and Healy "whose criminal careers apparently were due primarily to internal mental conflicts rather than to external circumstances," although the authors hasten to remark that these will be found to be the usual causes. Psychoanalysis of a thief revealed the following characteristics:

A strong sense of inferiority, leading to over-compensation in a feeling of bravado and toughness.
Feelings of guilt toward a brother and the attempt to relieve them.
Spite reaction toward his mother.
Desire to indulge in a carefree, vegetative existence.
Gratifying his infantile, parasitic wishes, satisfied by existence in prison.

FUNDAMENTAL FACTORS

Four sets of determinants have been revealed by four different methods of analysis, namely by deduction, by statistical techniques, by the case-study method, and by the psychoanalytic method. Although there is some overlapping of the lists of factors thus derived, they are on the whole of a different order. Is one of these sets of determinants correct and are the others wrong? Or do they merely represent different names for the same characteristics expressed upon different levels of description? Does one list represent a crude classification and another a more refined one? Is one list more complete than another? Each set of characteristics is in a sense a function of the method by which it is derived, for the method predetermines in part what factors shall be sought. Out of this variety of assumed determinants it should be possible to select those that are fundamental. The method of factor analysis suggests itself as one feasible mode of doing this (*291,* 37-88). Earlier chapters have shown that it is possible to select the fundamental function underlying manual skill, personality, and interest in

normal persons, and researches are in progress to make such analyses. There would seem to be no more important place to seek for fundamental factors than in the determination of criminal behavior. For discovery of underlying conditions is a first and necessary step towards prevention.

29

The Witness and the Accused: The Determination of Guilt

A survey of the literature shows very clearly that in recent years the American psychologist's interests and researches in the field of the law have been directed mostly toward the understanding, analysis, and prevention of criminal behavior, to the partial neglect of earlier areas of investigation. These had been concerned with such psychological problems as the determination of guilt and the credibility of witnesses. Part of this shift of activity has resulted from the fact that the accumulation of data from research on the normal sensory, perceptual, and memory processes, and from special research on testimony have given definite answers to the most pressing questions of this nature. The failure of the American legal system to accept and make use of the results of research in psychology has, too, tended to divert interest to more productive areas. The most important aspect of this body of knowledge will be briefly surveyed.

All the mental processes are involved in the functions of reporting and definite limits are set to the quality and quantity of testimony by the characteristics of those who testify. To attempt to exceed the normal limits of sensory acuity, of perception, of judgment, of memory, and of reasoning will be certain to introduce confusion and error. It is not fair to any witness to demand from him greater accuracy of report and range of information than his capacity makes possible. These matters have received considerable attention in the history of the law. The ancients were sufficiently interested to enumerate various illusions of perception to which observers are liable. Especially during the last one hundred years there have appeared from the hands of jurists, lawyers, and psychologists a great variety of treatises, discussions, and reports bearing on what Bentham, in 1800, called "the psychological causes of correctness and completeness in testimony."

The newspaper account of almost any trial in which sincere witnesses

independently report their versions of an event will disclose in a most instructive way the importance to judge, lawyer, and jury of a knowledge of the psychology of attention, perception, memory, imagination, suggestion, and belief. At the same time, a detailed examination of such a newspaper account, as to the nature of the questions asked, the manner of asking them, and the type of information demanded of the witness, will show that available knowledge of these psychological processes is frequently disregarded.

INDIVIDUAL DIFFERENCES IN CAPACITY TO GIVE TESTIMONY

Numerous investigations, initially suggested by the work of Cattell, Binet, Stern (*582, 3-20*) and others (*701, 375-408*) have endeavored to go beyond the general exposition of the psychological tendencies involved, and to secure precise measurements of them. Setting out from the well-known fact that observation, memory, and report are all liable to error—errors on the part of the observer, errors in the processes of recollection and memory, errors in the process of communication, and errors in the interpretation of what is heard—they have attempted to determine by exact experimental methods the nature, degree, and causes of these errors and their dependence on such factors as age, sex, practice, intelligence, time interval, mode of report, and degree of suggestion.

In addition to a general knowledge of the mental functions, it is necessary to know the way in which one individual differs from another, and above all, to have some indication of the particular qualifications of each witness who gives evidence, so that what he reports may be properly evaluated. It was suggested a quarter of a century ago by students of criminology that the proper handling of witnesses requires that a psychological expert be attached to every criminal court, so that, whenever necessary, psychological tests can be applied to determine the mental peculiarities of a witness. An examination might not be necessary for every witness, especially when his testimony is of a routine sort and has no critical bearing upon the case. When the testimony is about a complicated and critical situation, when contradictions arise, or when it is suspected that the witness is lying or withholding information, such examination is expedient. Samples will be given of the normal limitations of mental reactions and of the kinds of individual differences that may be expected in the functions commonly exercised in legal procedure, when the individual is doing his best to reproduce the facts of his experience. A good general impression of the reality of individual differences may be obtained from the statement

of Binet to the effect that, of the descriptions given by 150 people of a simple picture, no two were alike. As the picture was being observed during the descriptions, all question of memory differences is eliminated. It is evident, therefore, that no two persons saw and interpreted this simple scene in the same way.

LIMITATIONS OF SENSATION AND PERCEPTION

Errors in report may arise from the limitations and distortions of the original experience because of the nature of the sensory apparatus. For instance, in the case of hearing it is extremely difficult to identify sounds as of a certain character and often impossible to assign them to their cause. The following incident cited by William James (*314*, Vol. II, 100) from his own experience will illustrate the distortion of auditory events by a normal person.

> Sitting reading late one night, I suddenly heard a most formidable noise proceeding from the upper part of the house, which it seemed to fill It ceased, and in a moment renewed itself I went into the hall to listen, but it came no more. Resuming my seat in the room, however, there it was again, low, mighty, alarming, like a rising flood, or the *avantcourier* of an awful gale. It came from all space. Quite startled, I again went into the hall, but it had already ceased once more. On returning a second time to the room, I discovered that it was nothing but the breathing of a little Scotch terrier which lay asleep on the floor.

The direction from which sounds come is subject to as much misinterpretation as their quality and intensity. The mechanism for direction finding, involving the two ears, is such that it is impossible by sound alone to determine whether it comes from above, below, in front, or behind as long as the real source of the sound is equidistant from the two ears. Sounds that come from points *almost* equidistant from the two ears are subject to great errors of localization. Important consequences frequently depend upon the testimony concerning the character and direction of pistol shots, cries, splashes, thuds, and crashes.

Distortions of experience in normal vision are even more common than those of hearing. Colors are particularly difficult to identify correctly especially in weak light or in a slightly colored illumination. Any one who has attempted to purchase a necktie or other colored article in dull daylight or artificial light, or to match colors under such circumstances, is familiar with this phenomena. If the intensity of general illumination is gradually reduced, the quality of colors will change, so that red turns dark or becomes black, whereas blues and greens may now be correctly seen. With greater reduction of light, orange turns black, and finally the blues disappear.

The size and distance of objects seen in dim light or in a fog are

especially liable to serious distortion because the criteria upon which such perceptions depend break down under these circumstances. Witnesses frequently give conflicting testimony concerning the color tint of the smoke created by an exploding bomb, which would reveal the nature of the explosive substance, the color of a hat or other garment, the distance between two objects or persons. They frequently report fine details of objects seen in a dim light that would be beyond the capacity of vision under the circumstances. Hirschberg (*262*) cites a case in which an innocent person was convicted of murder on the positive identification of him by a witness. A higher court reversed the decision on the ground that the dimness of the light together with the distance of the observer made sure recognition highly improbable.

By means of the skin senses, and without the aid of vision, it is often impossible to distinguish between contact with a cold object and a wet object. The other senses suffer similar significant limitations. Further, sensory limitations peculiar to the individual must be noted, such as color blindness or color weakness, poor visual acuity, poor hearing, poor sense of direction, in order that testimony may be given its due weight. A condition of visual "form blindness" has recently been identified by Osborn (*473*) as a factor of confusion in the process of recognition of objects and persons and the estimation of distances.

ERRORS OF JUDGMENT

Judgments and estimates growing out of perceptual experience, which are frequently called for in legal procedure, not only are subject to the errors peculiar to perception but undergo further distortion in the process of interpretation. The speed of moving vehicles and other objects, the number of persons in a group at a given moment, the amount of time elapsing between two events, have been judged and the amount and the nature of the error that is to be expected have been calculated. An experiment by Richardson (*517*) on the judgment of the speed of automobiles is interesting because of the frequency with which the speed at which a car was traveling forms an important bit of evidence in cases involving serious accidents. Twenty-nine judges estimated the speed at which automobiles and motorcycles passed a given point. The cars ranged in character from a powerful eight-cylinder car to a small four-cylinder car, and the carefully controlled rates of speed varied from six to sixty-eight miles an hour. Although the detailed data are not presented, the investigator drew the following conclusion:

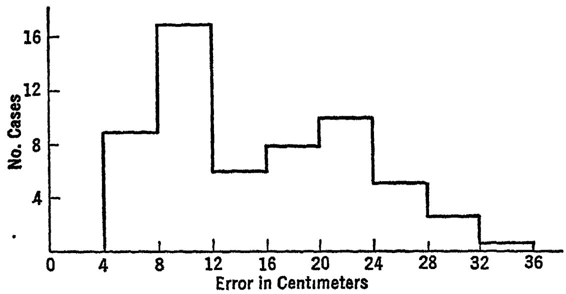
> The estimations show marked irregularity and variability depending upon the size of the car, its noisiness, the rate at which it passed, the contrast of that rate with the one just previous, and the amount and kind of experience which

the observer used as a basis of comparison. At high rates of speed, the observers were biased by their estimations of the probable maximum rate for such a car, resulting in marked underestimations Estimations *en route* by automobile drivers and passengers have been collected which reveal an even more complicated judgment. Visual, auditory, cutaneous, kinaesthetic, and organic impressions seem to contribute to such judgments.

This experiment, performed under circumstances most favorable for reliable judgment in that the observers were under instructions and did their best to judge accurately, demonstrates the variability and inaccuracy to be expected under ordinary traffic conditions, where the attention is not directed to the need for judgment. Burtt (*71*, 40) refers to an instance in which a jury was instructed to take into account the probable overestimation of the speed of an electric train because of its noise.

FIGURE 109

ERRORS IN ESTIMATION OF SPEED *



* From A P. Weiss and A R Lauer, "Psychological Principles in Automobile Driving," *Ohio State Univ Stud. Contr Psychol*, 1931 (c), No 11, 67.

The ability to judge the speed of moving automobiles is recognized as a prerequisite for safe driving, and batteries of drivers' tests include a speed-estimating test. Weiss and Lauer (*688*, 62-72) describe such a test, which requires the subject to judge the speed of a moving pointer, so that after it has passed behind a screen he can indicate by pressing a button the moment at which it will arrive at a designated spot. Errors in time are transmuted into centimeters of distance, the speed of movement being known. Figure 109 shows the distribution of scores for fifty-nine subjects; the base line showing errors in centimeters and the vertical scale the number of cases. The errors are seen to vary all the way from 4 to 36 centimeters. As the pointer is invisible only over a distance of 69 centimeters, the largest error amounts to just about 50 per cent. If this test really measures ability to estimate the speed of moving vehicles, its results are directly applicable to the witness who testifies as to the speed of traffic.

Estimates of number show errors of a similar sort. When the number

of spots on a card is estimated (the actual number being fifty) the answers vary from twenty-five to 200, with a very pronounced tendency on the part of most judges to greatly exaggerate the number. When the number is twenty, the answers range from ten to seventy. Judgments of the number of persons in a college class, in a theater, in an athletic stadium, or in a street crowd are subject to a like or greater distortion. More interesting even than the amount of the error is the apparent absence of all uniformity in the criteria of judgment from one observer to another.

Among the many variables upon which the accuracy of estimation depends is the attitude of the persons making the estimate. Ansbacher (*15*) has shown by experiment that the judged number of objects in a group will depend, among other factors, upon their relative value. Under certain circumstances a collection of two-cent stamps appears larger than the same number of three-cent stamps. When such variables as these are at work under experimental conditions, we may expect them to have a still larger influence in the testimony of witnesses.

Numerous laboratory studies show the nature of time estimation and the factors on which accuracy of estimation depends. Where there is a direct intention to estimate time intervals the error is very great, and this increases when the judgment is retrospective, as in most cases of testimony. Axel (*18*) has shown by carefully controlled experiments that, with adults acting as judges, the estimated duration of a twenty-second interval varies among individuals from five seconds to one hundred seconds, and the estimated duration of a thirty-second interval varies from five seconds to 155 seconds. In addition to these individual differences, there are important sex and age differences. The matter is still further complicated by the fact that the character of the events occurring during the interval influences both the direction and the amount of the error of estimation. On the whole, the simpler and more routine activities induce overestimation of time intervals, and the more complicated and varied activities lead to underestimation.

There are, however, necessary qualifications to any generalized statement. For instance, Swift and McGeoch (*600*) found an overestimation of intervals from thirty seconds to five minutes, whether the interval was filled or empty and regardless of the age and sex of the subjects. But the ten-minute interval was underestimated when the interval was filled by *doing* something whether interesting or not, but seemed longer than it was when it was filled by *listening* even to interesting material.

Gulliksen (*232*) filled a 200-second period of time with one or another of eight different activities and had over 300 students estimate

the length of the interval. He found the error to depend upon the nature of the activity as indicated in Table 68, being overestimation in some instances and underestimation in others.

TABLE 68

EFFECT OF ACTIVITY UPON ESTIMATION OF TIME *

Activity	*Average Estimate in Seconds*	
Resting	241 7	Over
Fatigue—Holding arms out from body	228 4	
Listening to metronome—slow	223 7	
Listening to metronome—fast	214 1	
Pain—Pressing palm on sharp point	210 2	
Mirror drawing	181.8	Under
Taking dictation	174 6	
Division problems	168.9	

* Adapted from H. Gulliksen, "The Influence of Occupation upon the Perception of Time," *J. of Exp. Psychol*, 1927, *10*, 53.

Finally, Woodrow (*707*), who investigated shorter intervals from two-tenths to thirty seconds, found no consistent error in any case, either toward underestimation or overestimation, and no consistency within a given subject on different occasions. In fact he concluded that the nature of the estimate depends both upon objective circumstances and upon the attitude of the subject, the latter being a fickle factor. From these experiments it can be said that one cannot count on accuracy of temporal report, that it is subject to a great variety of influences objective and subjective, and that the effects upon it of any set of circumstances are unpredictable in any individual case.

The experiment of Boring (*52*) resembles more nearly the conditions of everyday life. He asked a group of forty-four persons to estimate the time spent in viewing a motion-picture scene. The actual time, which was one minute, was estimated to be about ten seconds to about 400 seconds. Errors of this magnitude would in many cases make testimony entirely useless, for the time intervening between a pistol shot and a cry, or between such a shot and the appearance of a person at a given point, often a matter of a few seconds, may be of great consequence. Conflicting testimony is in such cases no necessary indication of intent to deceive, but is probably the outcome of simple errors of estimation.

THE FALLIBILITY OF MEMORY

The weakness of testimony as a result of the fallibility of memory has received most attention, probably because errors from this cause

are so very obvious. Numerous laboratory experiments have been devised for measuring just what degree of fidelity of report can be expected under good circumstances. Descriptions of pictures from memory, in the form either of narrative or the answers to a series of questions, furnish a simple means of illustrating the discrepancy between fact and the memory of it. The experiment by Boring (*52*) called for a report on a motion-picture scene lasting one minute. The observers were not told that they would be subjected to a memory test, but were instructed to pay careful attention to the picture. Immediately after the picture was shown, the observers dictated an account of all that they had seen. Then each one answered twenty questions based upon the picture. Table 69 shows the average percentages of the total material that were reproduced both in the narrative and questioning. As the

TABLE 69

THE FALLIBILITY OF REPORT *

	Percentage Reported		*Percentage Certain*		*Percentage Attested*	
	Total	Right	Total	Right	Total	Right
13 women	38.2	25 1	35.3	23.7	25 8	18.8
11 men	42.1	32 6	40.6	31.2	26 0	22.6
8 girls	32.5	20.1	30.0	19.2	17.5	13 4
12 boys	35.2	20.5	32 8	19.7	23 5	15.7

* From E G Boring, "Capacity to Report upon Moving Pictures as Conditioned by Sex and Age," *J. Crim. Law and Criminol*, 1916, *6*, 826.

experiment was intended primarily to discover sex and age differences, these groups are presented separately in the table. In addition to reporting the items remembered, each witness indicated those of which he was certain, and those he would be willing to swear were correct. The table shows: in the first column, the character of the witnesses; in the second column, the percentage of items recalled, regardless of whether they were right or wrong; in the third column, the percentage reported correctly; in the fourth column, the percentage reported with certainty; in the fifth column, the percentage that were both certain and correct; in the sixth column, the percentage sworn to; and in the seventh column, the percentage that were sworn to and were correct. For our present purpose it will suffice to point out the relatively small size of the figures. Under circumstances such that the maximum of attention is guaranteed and with report called for immediately after the event, the best group reported only 42.1 per cent of the facts, and of these only 32.6 per cent were correct. Only 32.5 per cent were re-

ported by the poorest group, and of this amount only 20.1 per cent were correct.

Memories involved in testimony are almost always of the so-called incidental or unintentional sort. There is no definite intention to observe events and to remember them. Studies of incidental memory by Myers (*457*) and by Shellow (*556*) show that it is extremely weak and unreliable as contrasted with "intentional" memory such as is guaranteed by the nature of the usual "report" experiment. Events that are entirely within the power of memory to reproduce, both in nature and quantity, are lost unless there is the definite intention to remember them.

TABLE 70

INFLUENCE OF TIME INTERVAL UPON MEMORY *

	Narrative		*Questioning*	
	Number recalled	Percentage of error	Questions answered	Percentage of error
Immediate ..	765	10 5	880	14 1
5 days	735	14 3	855	18.2
15 days	750	18 0	854	20 7
45 days	569	22 4	801	22 4

* From K M. Dallenbach, "The Relation of Memory Error to Time Interval," *Psychol. Rev*, 1913, *20*, 328

All classes of facts that figure in evidence are affected, such as the size and number of objects, their form and color, and the passage of time. Achilles (*1*) measured the difference between incidental and intentional memory for different kinds of material under experimental conditions that are far more favorable to good incidental memory than entirely uncontrolled experiences, and free from emotional disturbance and shock. Expressed in terms of the strength of intentional memory, the incidental memory for syllables was 81.3 per cent, and the association of names with photographs was 57.2 per cent. In the light of such studies it would seem to be a conservative estimate that all values for intentional memory in testimony should be reduced about one half to indicate their incidental memory value. The few tests that have been made of naïve and unsuspecting observers support this estimate.

Legal testimony seldom rests upon experiences so favorable for correct remembrance as the events in these experiments. The immediate recall precludes all the weakening and distortion of the memory that occurs with the passage of time. The figures in Table 70, from an investigation by Dallenbach (*124*), may be taken as typical of the in-

fluence of time interval when all the conditions are favorable for correct memory. It will be noticed that the accuracy decreases much more rapidly than the quantity of material reported, both in the narrative and in the deposition (questioning). The error increases more than 100 per cent in the case of the narrative in the course of forty-five days. Such an interval is not a long one in legal affairs. The additional distortion that would be introduced through the frequent repetition of testimony before a coroner's jury, the grand jury, the trial jury, through the conferences with lawyers, and through the emotional excitement attending all the circumstances, can only be surmised.

A great deal has been learned about the nature of the distortion of memory that occurs with the passage of time, and particularly with repeated recalls at various intervals. Interest in the problem has been chiefly owing to its implications for Gestalt theory, but the facts disclosed by experiment are pertinent to the matter of testimony. One of the best known experiments is that of Wulf (*720*) who studied the changes occurring during repeated recall of visual patterns. He found rather systematic changes occurring in the direction of what he called "normalizing," which is a change toward some familiar pattern, and of the accentuation of certain features that had stood out in the original experience. Something like this does occur, although later investigators like Gibson (*205*) and Hanawalt (*240*) dispute his explanations and some of his conclusions. Stern (*582*, 6) refers to changes of this nature, along with others, in the following statement concerning the descriptive report of a picture:

> There is, first of all, a tendency to overstate the number of items, an inclination toward exaggeration which is a very common feature of remembrance. Thus in the successive descriptions of another picture there occurred the transformation of three trees, first into a grove and later into a veritable forest.... There is a second item worth mentioning. a substitution of items originating in a logical need for completeness. The woman described as being seated on a packing box, was actually sitting on a sofa. The insertion of the packing box, was... due to a need for logical completeness. The subject remembered the seated woman but not the object on which she sat; since she must have been sitting on something, he interpolated an obvious object.... This tendency toward logification—the transformation of the unordered and fragmentary chaos of memory images into an ordered, logically satisfactory, and reportable whole—gives rise to many errors in testimony.

Vickery and Brooks (*668*) staged a laboratory "crime" and obtained accounts of it from a group of eighty girls immediately after and during "high-pitched excitement," one week later, and seven weeks later. The immediate account was a voluntary, written report, whereas the other two were responses to questions. Among the many items of information given by the subjects were estimated eye color, height,

weight, and age of the three boys who participated; the date, day of the week, and time of the event. Table 71 gives the data for height and weight from the testimony after one week and after seven weeks. There appears to be a general trend toward concentration of the estimates toward a mid-point. This is evidence of a tendency to revert toward

TABLE 71

CHANGES IN TESTIMONY WITH TIME *

	Range of Estimated Weight in Pounds		*Range of Estimated Height in Inches*	
	One week	7 weeks	One week	7 weeks
Boy (1)	90—170	105—165	56—84	48—72
Boy (2)	100—160	95—150	48—76	56—70
Boy (3)	85—150	80—145	48—70	56—70

* Adapted from K Vickery and L M Brooks, "Time Spaced Reporting of a 'Crime' Witnessed by College Girls," *J. Crim Law and Criminol*, 1939, *29*, 373.

the more usual or common statures of people. Since the actual weights and heights were not given, the accuracy of the estimates on the different statements cannot be determined. There was "very little agreement" between the voluntary narrative and the replies to questions, and the correlation between the two sets of answers six weeks apart showed "the reliability of report too low to be considered significant." The many other conclusions cannot be reproduced here.

INFLUENCE OF SUGGESTION UPON THE QUALITY OF REPORT

It has long been known that the way in which a question is asked has an important influence on the actual correctness of the answers made to it. By various details of its construction, the question may convey implications, suggest replies, or eliminate alternatives. In legal procedure the "leading question" is regarded as a possible source of fallacious testimony, but there has not been a clear discrimination among the various types and degrees of leading questions.

The early investigation of Muscio (*453*) may be referred to by way of illustration. Using motion pictures as material for observation, he asked questions, all of them of a leading character, and tried to measure the influence of different question forms upon the percentage of right answers, wrong answers, and uncertain answers. The percentages for right and wrong answers, together with the number of times each question form was used, are given in the first four columns of Table 72.

TABLE 72

THE INFLUENCE OF LEADING QUESTIONS *

	Times Asked	*Percentage Right*	*Percentage Wrong*	*Uncertain (Caution)*		*Suggestiveness*		*Reliability*	
				Per cent	Order	Per cent	Order	Per cent	Order
Did you see a ——?	198	15	4	81	2	89 2	2	78 4	1
Did you see the ——?	355	16	10	74	4	62.6	5	61 5	4
Didn't you see a ——?	226	11	10	79	3	91 7	1	52.0	6
Didn't you see the ——?	179	9	5	86	1	84.0	3	64 0	3
Was there a ——?	325	32	18	50	5	43 6	7	64.2	2
Wasn't there a ——?	341	31	24	45	6	51.8	6	57 0	5
Was the (k) m or n?	251	30	30	40	7	77.5	4	49 7	7
Was the (k) m?	355	32	34	34	8	39 7	8	47 8	8

* From B. Muscio, "The Influence of the Form of a Question," *Brit J. Psychol*, 1916, *8*, 309 and 375

In the last six columns are the values of the questions in terms of caution, suggestiveness, and reliability. Caution is indicated by the number of times a person reports that he "does not know"; suggestiveness by the number of times that the "lead" of the question was followed; and reliability is calculated by finding the percentage of the answers that are right.

The results led Muscio to the following conclusions: By using the definite article, *the,* instead of the indefinite article, *a,* the suggestiveness, caution, and reliability were all decreased. Introducing the negative, *not,* into the question decreased caution and reliability and increased suggestiveness. By asking whether certain things were present or occurred, rather than whether they were seen or heard, suggestiveness, caution, and reliability were all decreased. By asking concerning the presence or occurrence and also including the negative, suggestiveness and caution were decreased. Including both the definite article and the negative gave more complicated results. The so-called "implicative" question, "Was the (k) m?" was found to be "lower than all the other forms investigated, for suggestiveness, caution, and reliability." The "incomplete disjunctive" form, "Was the (k) m or n?" was found to possess a "relatively high suggestiveness, a relatively low caution, and a relatively low reliability." In general and with certain qualifications the investigator concluded that the most reliable form of question was that which related to the actual seeing or hearing of an item, using neither the negative nor the definite article.

Burtt and Gaskill (*75*) showed motion pictures to groups of students and immediately afterward asked a series of questions having the same form as those of Muscio. Although they disagree with Muscio concerning the exact influence of certain of the question forms, they confirm his conclusions that the way in which the question is stated may to a certain extent predetermine the answer that will be received. The recent extensive use of the public opinion poll has revived the interest in the suggestive value of questions. Test surveys have been conducted under the auspices of the American Institute of Public Opinion, the Psychological Corporation, the magazine *Fortune,* and by individuals. The principal findings of these studies have been summarized by Blankenship (*47*):

1. Where alternative answers to a question are to be checked, the position of a given answer may affect the frequency with which that answer is checked by as much as 2 to 3 per cent.
2. Where possible answers are furnished in a list to be checked, the response will be determined by the particular items chosen to appear in the check list.
3. Questions in the negative form tend to be confusing.

4. The use of certain words such as "fascism" and "conservatism" in a question can influence the response by the arousal of prejudice.
5. The reference to persons in a question may influence the response. Thus it was found that when the idea of having the Thanksgiving celebration a week earlier was stated to be President Roosevelt's idea, it received an additional approval of 5 per cent.

These, together with the factors investigated by Muscio, need careful consideration in formulating questions for the elicitation of testimony. The best rule to follow in the use of questions is to study them most carefully for possible sources of error, guarding particularly against devices known to be misleading but being on the watch for others that may be peculiar to the case in hand.

INDIRECT PSYCHOLOGICAL INDICATORS OF EVIDENCE

In the accumulation of evidence either from witnesses, or from suspected or accused persons, it is necessary not only to properly evaluate that which is given voluntarily and with all possible assistance from the witness, but to elicit it where there is unwillingness to cooperate or where there are definite efforts to withhold information. The application of psychology to these problems is more spectacular but no more important than the applications already considered. Many methods have been and still are in use for this purpose which have a good psychological foundation, although they can scarcely be called psychological methods. Among these is the method of exhaustion, by which the individual is kept awake and answering involved questions for many hours until his resistance and control finally break down and he tells all that he knows, and sometimes even more than he knows, just to get relief. The method of intimidation by which the individual is threatened with bodily harm if he does not tell the truth, and the use of sudden fright are sometimes resorted to. They are all similar in that they tend to break down the control which one normally exercises over his responses.

THE ASSOCIATION TEST

The strictly psychological methods make use of responses, that, under ordinary circumstances, are not under the control of the individual, and which will, nevertheless, serve as indicators of knowledge. A number of such indicators have been suggested and tried, among them the association reaction, the breathing, blood pressure, and the psychogalvanic reaction. The first of these, the free-association method, is the best known. It has come to be a favorite form of demonstration

in many psychological laboratories, and in one of its forms is usually conducted in the following manner. Three members of the class are sent out of the room in charge of an assistant, who selects one of the three to play the rôle of "criminal" in the test. This person is put through some experience in which the two remaining students do not participate—is shown a picture, read a story, or instructed to perform some more or less exciting act. The three students are then brought into the classroom one at a time and are given the free-association test. A list of words has been prepared which contains some that are simple and unrelated to the experience and some that are called "critical." These are the words that are closely related to the experience through which one of the three students has just passed. If, for example, he had seen a human skeleton standing in the corner of a dimly lighted room, part of the list of words might be as follows, where the critical words are italicized:

sweet	*skull*	chair	paper
dark	city	color	desk
grass	*bones*	*dead*	*ghost*

The list of words is read to the person one word at a time and he is required to reply quickly and with the first idea that comes into his mind. These association responses are recorded and in each case the time that has elapsed between the presentation of the stimulus word and the response is measured. The series is then repeated in the reverse order. In this manner all three of the students are examined and the instructor or the class judges, on the basis of the test results, which of the three "suspects" is guilty—which one possesses the special knowledge or experiences the special emotions produced by this knowledge.

The indications that the "guilty" individual will be likely to give in such an examination are:

1. Significant reactions to critical words.
2. Retarded reactions to critical words or to indifferent words following closely upon them.
3. Changed reactions to critical words when the reverse order is given.
4. Undue number of stereotyped or reverberating reactions.

The first indicator, the *significant reactions*, may be expected because the ideas connected with the "crime" should be deeply impressed upon the mind and hence most ready to offer themselves as responses to the critical words. The second indicator, *retarded responses*, results from the attempt to inhibit the incriminating responses and to select others in their places. The time consumed in doing this is easily measured with a stop watch. The fourth indicator, *stereotyped responses*, is also the result of an attempt to choose among possible responses instead of

giving the first and readiest one. The third indicator, *changed reactions*, appears when the second set of responses is compared with the first. If a significant reaction is inhibited the first time, the emotional excitement will be likely to interfere with the memory of the response that is given, so that, upon a second presentation of the critical stimulus word, the significant one will again tend to come to mind. If this is inhibited, and the one just given cannot be recalled, a new response will have to be found. Such a changed reaction is not normal, for if the instructions are followed and the first idea that comes to mind is given, this will be the same in both cases.

When skilfully conducted, the experiment in this form seldom fails. The procedure has been suggested as a means of indirectly securing evidence which the direct interrogatory, cross examination, or "third degree" might fail to reveal, and the application of the method in police and court procedure has been enthusiastically advocated by some psychologists. The practical merits of the method and its ultimate possibilities are still open to discussion. It should, however, be noted that in the form here described the problem is only that of determining which of a number of individuals is the guilty one, whereas the practical problem, that of determining the guilt or innocence of a given individual, is a much more difficult matter.

Marston (*398*) used a somewhat modified technique to determine the effect upon speed of association reaction of the attempt to lie, as contrasted with telling the truth. He found three types of persons in his group; the positive type, whose time is lengthened and made more irregular; the negative type, whose time is shortened; and a mixed type, in which the individuals fluctuated between shorter and longer reactions when attempting to lie. The persons in the first group reported a mental state of fear, confusion and distraction, whereas those in the second group reported a certain tendency to distraction but an ability to overcome it. The practical application of the method is made difficult by these type differences, although the experimenter, after classifying his subjects, reported that he succeeded in judging deception correctly in 75 per cent of the cases.

PHYSIOLOGICAL INDICATORS OF GUILTY KNOWLEDGE

Other methods proceed on the assumption that emotions are attended by characteristic physiological reactions, among which are included gross external muscular innervations, changes in respiration and heart beat, vascular adaptations, and changes in the secretion of various glands, such as the salivary and the sweat glands. The further assump-

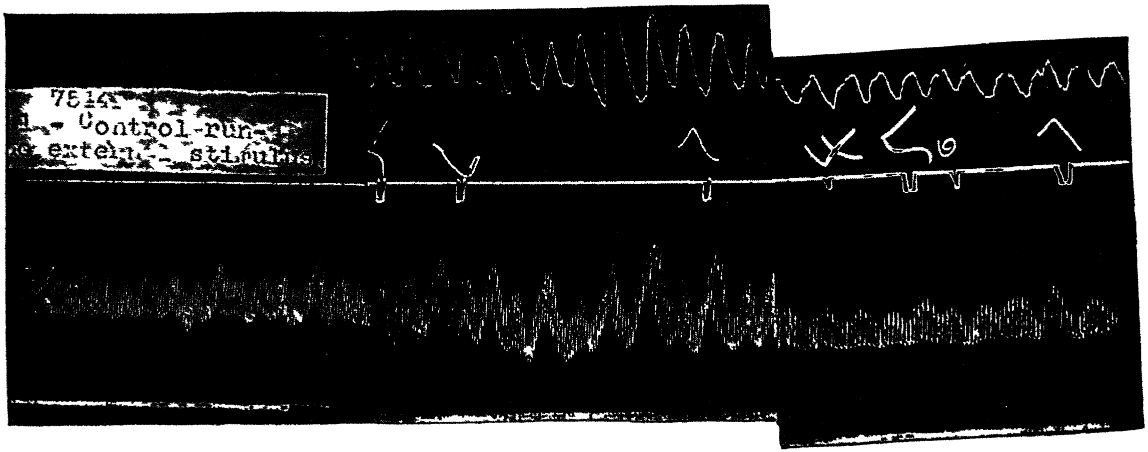
tion is necessary that these mechanisms respond differentially to excitement, fear, anger, and a deceitful attitude of mind. By the use of appropriate recording apparatus—sphygmographs, pneumographs, and galvanometers—the organic changes that occur during such an examination as that of the preceding experiment may be registered, and may furnish significant indicators of guilty knowledge. Benussi (*36*) reported that the truth or falsity of an oral statement could be detected by noting the ratio of length of inhalation of the breath to length of exhalation before and after the statement. The fraction, inspiration divided by expiration, he said tended to be larger immediately after a lie has been told than immediately before, when it was being planned, whereas the reverse was the case when the truth was being told. What is probably indicated is the greater concentration of attention and general tension required to lie successfully, with a sudden relief of tension as soon as the lie is told. It is likely that an increased tension from any cause whatever would produce similar breathing changes. Although other researches such as that of Burtt (*70*) followed the suggestive work of Benussi, the inspiration-expiration ratio has given place to other more promising techniques.

BLOOD-PRESSURE TEST

Interest has been directed in recent years to changes in blood pressure as an indicator of deception. Systolic blood pressure is raised by emotions of fear and anger, which are believed by Marston (*397*) to constitute "largely" the deceptive consciousness. This investigator reports 100 per cent success in discovering deception. The "blood-pressure method" has been employed on the most elaborate scale by Larson (*363*) (*364*). He obtains a continuous record of blood pressure and breathing before, during, and after a series of questions or association words pertaining to a critical situation. Deception is indicated by a rise in blood pressure and a disturbance of breathing. The record reproduced in Figure 110 was obtained during the examination of an individual who was suspected of having taken a twenty-dollar bill. Three records are included on the chart, the upper one a breathing curve, the next one a time-signal line showing when the different questions were asked, and the lowest one a continuous blood-pressure curve. The first third of the chart indicates the control or rest period when no questions were asked. At the point marked "5" the question, "Do you like to dance?" was asked. At "6" the question, "Did you take a twenty-dollar bill from the house?" was asked. At this point the breathing becomes disturbed and the blood pressure rises. The last third of the chart shows the reactions to the same questions after a confession

FIGURE 110

CHRONOGRAPHIC RECORD OF BREATHING AND BLOOD PRESSURE CHANGES UNDER EXAMINATION *



* From J A Larson "The Cardio Pneumo Psychogram in Deception," *J Exp Psychol* 1923, *6*, 420

was obtained and indicates that there is no longer any disturbance of mind. The blood pressure, therefore, is said to vary under four sets of circumstances, at rest but after confession, during non-significant questions before confession, during significant questions before confession, and after confession when questions cause no change. Larson cites an imposing array of actual cases in which the cardio-pneumo-psychograph has demonstrated its utility as an indicator of deception.

PSYCHOGALVANIC-REFLEX TEST

The psychogalvanic reflex which appears to reflect changes in the secretion of the sweat glands incident to the arousal of an emotion has been thoroughly examined as a possible index of guilt. But up to the present time this method has been able only to indicate that some emotion or excitement is present. The character of the emotion, its

TABLE 73

RELATION BETWEEN MENTAL STATE AND MAGNITUDE OF PSYCHOGALVANIC REFLEX *

Mental State	*Magnitude of Response in Ohms*
Tension	1,248
Startle, surprise, fear	846
Confusion	740
Amusement	514
Expectancy	401
Inhibition, uncertainty	319
Unpleasantness	260
Effort	169
Pleasantness	105

* From R S Woodworth, *Experimental Psychology* (New York, Henry Holt and Co., 1938), p. 292.

basis and deep-seated significance, cannot be inferred from the records. Landis and Hunt (*357*) obtained the psychogalvanic responses to a large variety of stimulus situations, at the same time obtaining introspective reports of the mental state created by each stimulus. They conclude that this response accompanies every type of stimulus and every type of conscious content, that is to say, it is not specific to any stimulus or any mental state. However, they did find differences in the frequency with which a galvanic deflection accompanied a given mental state, and the magnitude of the response. Woodworth (*711, 292*) worked over the data given by Landis and Hunt, and derived the results shown in Table 73 which give for a series of mental states the average magnitude of all the responses (including zero responses). Tension, however it is created, was the most potent influence upon the reflex response, whereas the feelings, pleasant or unpleasant, were the

least effective. When an introspectively reported state of tension is subjected to a more refined analysis, it appears that the significant determinant or concomitant of the reflex response is a "sense of check or predicament, the shock of encountering something for which one is not prepared, a brief maladjustment, usually with quick recovery" (*711*, 296). A consciousness of guilt might very well bring on this condition although other circumstances could equally readily induce it. Only in the case where these other effective variables were ruled out could changes in the psychogalvanic response be associated with guilt.

BRAIN-WAVE PATTERN TEST

The latest newcomer in the field of psychophysiological indices of guilt and deception is the electroencephalogram. The brain-wave pattern is known to be modified in the course of a change from a state of rest to excitement, hence the question has arisen whether there is a wave pattern characteristic of these specific states of mind. Oberman (*471*) recorded the electroencephalograms of thirty-three students in two typical laboratory situations, one of which called for false reports of numbers seen and the other called for association reactions concerned with a presumed automobile accident. Five judges attempted to select from a series of control and "indicative" records those that were associated with the critical experience. Although the judges differed in the degree of their success, and although the subjects differed among themselves in the degree of the sensitiveness of their wave patterns to the stimulus conditions, nevertheless, Oberman reports correct identification. In the case of deception the results were 130 per cent better than chance, and in the case of guilt 140 per cent better than chance. It appeared to make no difference, so far as ease of identification was concerned, what the normal wave pattern of the subject might be. As the title of this study shows, the experimenter was measuring *mild affective states*. How specific the wave changes are to the guilt and deception states remains for further research that would be designed so as to distinguish the effects of guilt and deception from the effects of mild affective states otherwise aroused.

DETERMINING THE INTENTION OF A CRIMINAL ACT

The intention or intent, which is an extremely important factor in the legal conception of guilt and the degree of guilt, is a peculiarly psychological phenomenon. It is a state of mind that can be known directly only to one's self. And yet it is the presence of intent as contrasted with impulse that establishes an act to be a crime of a certain

magnitude. To make the problem still more difficult, the law distinguishes between simple intent and premeditated intent. Murder with premeditated intent is first-degree murder whereas murder with intent only is second-degree murder (*61*).

Intent obviously must be inferred from some kinds of signs or indicators. A simple way out of the dilemma has seemed to be to presume that a person intends the natural and probable consequences of his acts (*404*); that is, he intends to do what he does. If one person shoots another, the presumption would be that he intended to do so. But he might not have known that the gun was loaded when he aimed it, or he might have known that it was loaded but did not intend to pull the trigger. It might be expected that a person's intentions could be discovered from his statements about his intentions, as in the case where some one had threatened to shoot another, or had stated that he would like to shoot him. However, an individual might make such statements and later change his mind before an accidental shooting occurred. Still another approach is by way of knowledge of the consequences of an act. If one knows the certain or probable consequences of what he does, then he intended to do what he did. But the psychologist knows that there may be knowledge in the presence of an overpowering impulse, or in the absence of the inhibitory power to restrain action. One other basis for finding intent, elaborated in detail by Britt (*61*), is the interval of time between the provocation and the act. If the time is very short, then intending or deciding could not have occurred and the act must have been impulsive. Britt shows by a review of research on simple, discrimination, and choice reaction times, that all of these processes fall within a time range too short for practical legal distinction to be made among them.

In legal practice it is customary to build up a case of intention from circumstantial evidence. A very simple instance is cited by Britt in which one person struck another over the head with a bottle. That might have been the result of an impulse, but if the assailant struck his victim a second time that would indicate that he intended to do something that the first blow did not accomplish. The "banana-peel case" mentioned by McCarty (*404*, 155) was decided on circumstantial evidence. It was a case of obtaining money damages from a railroad company after an accident in which the claimant had slipped on a banana peel. Investigation of the individual's record disclosed several other instances in which he had collected damages from injuries received in essentially the same manner. The presumption would be, therefore, that there is slight probability of several similar accidents of the sort occurring by chance to the same person; hence the act was intentional.

Circumstantial evidence thus comes to rest upon a process of calculation of probabilities. What is the probability that a certain simultaneous combination of circumstances, or a consecutive series of events could occur by chance? A decision in such a case seems to depend upon the calculations of common sense rather than upon a mathematical computation of probabilities. It is here that the jury is called upon to express the common-sense reaction of "the people." These and other problems confronting the jury will be discussed in the next chapter.

30

Psychology of the Jury and the Judge

The examination of the problems involved in getting evidence from witnesses and accused persons is only the beginning of the service that the psychologist can render in the administration of the law. The following concise statement of the legal process by Osborn (*474,* 4) brings out other aspects that are packed with psychological problems:

> In civil cases a quarrel between two of these strange dwellers on the earth brings them and their lawyers into court for settlement of the difficulty, and in criminal cases the prosecutor and the defendant and his attorney appear. Each side tells its story to the jury; friends and neighbors and by-standers are called, and they say what they know about it, and the jury listens to it all, and then a lawyer on each side says what he wants the jury to believe, and the judge usually says something about the law and then the jury goes out to the jury room and decides which party has right on his side, or perhaps which one is most to blame.

The psychologist could profitably analyze the function of the prosecuting attorney, of the lawyer, of the expert witness, of the jury, and of the judge. Only the last two will be discussed in this chapter.

THE FUNCTION OF THE JURY

A careful reading of the following simple statement from Osborn (*474,* 8) will give an inkling of the task that is imposed upon the jury.

> Jurors are expected to discover not only the errors, or the perjury, of the witnesses but also the errors and fallacies of the lawyers, which often are even more puzzling, and it thus clearly appears that the most difficult work in the courtroom is given to the jurors. The proceedings seem to be conducted on the amusing assumption that the juror's knowledge, shrewdness, mental power and agility, experience in affairs, knowledge of human nature and his sense of right and honor, will lead him to decide correctly which contestant is right and which lawyer is right, in all kinds of complicated controversies. In many cases this assumption is not simply amusing, it is tragic!

What are the qualifications for the satisfactory performance of the juror's task? (*474*, 97)

> To do his work perfectly in all kinds of cases... a juror should be an experienced business man, a trained psychologist, an accountant, a personnel expert, a man of good common sense, an educated man with a thorough knowledge of language and logic; he should know something of the poor and unfortunate and those easily led astray. He should have sympathy controlled by good judgment, and should be without prejudice against the rich or against the poor and, in short, should be a philosopher able to temper justice with mercy, but who can punish as well as forgive and not forget the past victim of crime nor the future victims who may suffer or die because of unwise sympathy for the criminal before him. Finally the juror should have a reliable knowledge of this vague and indefinite something we call human nature.

There are at least two reasons in justification of the heavy task imposed upon the juror. The first is that in a democracy the fate of any citizen should rest with a group of his fellows who live and think and act as he does. The second reason, and the more interesting one from the psychological point of view, seems to rest upon the belief that when decisions are to be made two heads are better than one and three heads are better than two. The choice of so large a number as twelve is probably the effect of the first reason rather than this second one, although there may be a belief on the part of people that when a vital decision is to be reached the more heads the better. Psychology has something to contribute on this latter point, out of the large accumulation of research on the process of opinion formation by individuals and groups (Chapter 13).

The functions of the jury from the psychological point of view can be analyzed into two stages. The first stage consists in reacting as an individual. Each juror, sitting in the jury box, must follow the complicated proceedings without collaboration from his fellow jurors. He must listen to narratives, follow arguments, inspect exhibits, and comprehend instructions from the judge; he must remember what takes place and must make decisions. The second stage begins when the jury room is reached, whereupon a consensus is to be hammered out of the specific reactions of the twelve individuals. This consensus involves the clash of personalities, some strong and some weak, the comparison of arguments pro and con, with consequent strengthening, weakening, and shifts of opinion.

THE FORMATION OF OPINION

Theoretical and research interest has been directed primarily to the second of these two phases of the work of a jury. Weld and Roff

(*690*) and Weld and Danzig (*689*) have made a notable contribution by directing research toward the processes involved in the first phase. These two experiments are unique in that they have established a technique for following the course of deliberations of the juror throughout a trial. The first experiment did not duplicate the court trial situation in that the "jurors" merely followed the report of a case, without the hearing of witnesses, arguments of opposing counsel, the summing up of the charge by the judge, nor did it include the discussions of the jury room. It did, however, provide a means of following the successive reactions of the "jury" as the evidence was unfolded. The report of a case covering one hour was divided into thirteen stages, and at the end of each stage each of fifty jurymen made a judgment concerning the guilt or innocence of the accused. This was done on a nine-point rating scale whose steps were as follows:

1. Certainty of innocence
2. Strong belief in innocence
3. Fair belief in innocence
4. Slight belief in innocence
5. Doubtful
6. Slight belief in guilt
7. Fair belief in guilt
8. Strong belief in guilt
9. Certainty of guilt

The first stage of the report (I) covered the indictment preliminary to the hearing of testimony; the next two (II and III) comprised presentation of witnesses by the prosecution; stages IV, V, VI, and VII covered defense witnesses; VIII and IX were further witnesses for the prosecution; X was a defense witness; XI was an exhibit offered by the defense showing the foot of the accused; XII was a final defense witness; and XIII was a report of the verdict which had been reached by the jury in the original trial of the case. Table 74 shows the distribution of the judgments on the guilt-innocence scale at the various stages of the report. The arrangement of the data will be clear without description. The figures in the body of the table give the distributions of the scale ratings. The median score at each of the thirteen stages will be found along the bottom of the table, together with the first and third quartiles. The most obvious result concerns the degree to which the median estimates rise and fall with the succession of testimony for prosecution and defense. The greatest change comes from the introduction of the exhibit of the accused person's foot to establish the presence or absence of scars.

Other parts of the research, in which the report was presented to fresh groups, furnished information concerning the effect of different

TABLE 74

THE DEVELOPMENT OF OPINION *

Scale		*Indictment*	*Prosecution*	*Prosecution*	*Defense*	*Defense*	*Defense*	*Defense*	*Prosecution*	*Prosecution*	*Defense*	*Exhibit*	*Defense*	*Previous Verdict*
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII
Certainty of guilt	9	1	4	11	1				4	8	5			
Strong belief in guilt	8	4	12	10	6	2	1		5	12	9			
Fair belief in guilt	7	6	15	16	7	5	2		7	11	7	1		
Slight belief in guilt	6	22	10	7	11	5	5	7	10	7	2	1	1	1
Doubtful	5	15	9	6	19	21	17	10	20	7	14	16	4	3
Slight belief in innocence	4	1			4	10	9	15	2	2	8	2	6	2
Fair belief in innocence	3	1			1	4	13	14	1	2	3	12	12	10
Strong belief in innocence	2				1	2	2	3	1	1	2	16	20	18
Certainty of innocence	1					1	1	1				2	7	16
Median score		5 8	6 9	7 3	5 5	4 9	4 5	4 0	5.6	7 0	5 4	3 1	2 4	2 0
Q_1		5.2	5 9	6.4	4 9	4 1	3 2	3 1	4 9	5 6	4 4	2 2	1 8	1 3
Q_3		6 4	7 8	8 4	6 7	5.5	5 2	5[illegible]	7.0	8 1	7 7	4 8	3 4	2 9

* Adapted from H. P. Weld and M. R Roff, "A Study in the Formation of Opinion Based upon Legal Evidence," *Am. J. Psychol*, 1938, *51*, 617.

orders of presentation of the evidence. In the second part the first three sections remained unchanged, but there followed all the sections having to do with the defense, and finally the remaining sections having to do with the prosecution. The order of the sections, together with the new median values thus obtained are:

I	II	III	IV	V	VI	VII	X	XI	XII	VIII	IX	XIII
7.5	7 6	7.6	5 6	4.8	4.1	3 6	3.4	2.3	2 2	4 4	5 4	4 4

In the third part all the sections of prosecution testimony were given first, followed by all those for the defense with the results as follows:

I	II	III	VIII	IX	IV	V	VI	VII	X	XI	XII	XIII
5.8	6 9	7 3	7.7	7 9	5 5	5.3	5 1	4.9	4.6	2.8	2.3	2.0

In part four all the defense testimony was given first—except section XI which carried the exhibit—then the prosecution, followed by the exhibit, thus:

I	IV	V	VI	VII	X	XII	II	III	VIII	IX	XI	XIII
5.3	5.2	4.5	3.6	3.3	3.4	3.4	6.2	6.5	7.1	7.8	3.5	2 2

There are a number of interesting phenomena that show up in these modifications of the order of presentation which the reader can work out for himself. In the case of certain sections, their importance depends upon their relative position, whereas others seem to maintain a value independent of position. When a continuous series of defense or a continuous series of prosecution sections occur, there is a cumulative effect, although the relative influence of the later sections in a series seems to diminish.

Individual differences in reaction to the testimony were noted. Four trends maintained more or less consistently by certain individuals have been pointed out by Weld and Roff. They were a protracted state of doubt, a tendency to be easily moved by evidence, a caution toward all evidence, and a tendency for judgments of succeeding sections to be heavily influenced by judgments made concerning preceding sections. Finally, there was a great variation among individuals in the degree to which they were impressed by any item of evidence regardless of its position in the report.

The investigation by Weld and Danzig (*689*) employed a setting more analogous to a court trial. It was a damage suit conducted in a realistic manner with a judge, prosecuting and defense attorneys, witnesses and cross examiners, with the judge's charge to the jury and with the deliberations and final decision of the jury of forty-one persons. The whole program, exclusive of the jury action, was divided into eighteen sections, and judgments concerning liability for damages were

TABLE 75

The Evolution of Jury Opinion *

Scale		I *Plaintiff—opening*	II *Defense—opening*	III *Plaintiff witness (1) Direct examination*	IV *Plaintiff witness (1) Cross examination*	V *Plaintiff witness (2) Direct examination*	VI *Plaintiff witness (2) Cross examination*	VII *Plaintiff witness (3) Direct examination*	VIII *Plaintiff witness (3) Cross examination*	IX *Defense witness (1) Direct examination*	X *Defense witness (1) Cross examination*	XI *Defense witness (2) Direct examination*	XII *Defense witness (2) Cross examination*	XIII *Defense witness (3) Direct examination*	XIV *Defense witness (3) Cross examination*	XV *Rebuttal*	XVI *Summing for Defense*	XVII *Summing for Plaintiff*	XVIII *Judge's Charge to Jury*
Liable	9																	1	1
Strong belief of liability	8	6	1	1		1	2	4	6	2	3				1	2		1	2
Fair belief of liability	7	6	2	12	3	5	5	6	9	5	4	3	3	3	3	6	1	4	5
Slight belief of liability	6	7	3	14	4	11	6	14	10	5	3	3	6		3	3		3	3
Doubtful .	5	16	22	5	9	16	14	9	12	10	13	7	6	4	4	11	7	8	9
Slight belief not liable	4	3	4	5	14	2	9	6	3	8	5	14	13	7	9	7	3	3	2
Fair belief not liable.	3	2	7	1	7	2	1	1		8	10	6	7	16	5	5	4	9	7
Strong belief not liable.	2		1	2	1	3	3	1	1	1	1	5	4	6	3	2	19	8	5
Not liable.	1	1	1	1	3	1	1			2	2	3	2	5	2		7	4	7
Not liable..		5.9	5.3	6.4	4.6	5.7	5.4	6.2	6.4	5.1	5.1	4.4	4.5	3.5	4.5	5.3	2.7	3.9	4.7
Q_1		5.2	4.3	5.2	3.8	5.1	4.5	5.2	5.5	3.9	3.7	3.3	3.6	2.8	3.5	4.2	2.1	2.7	2.6
Q_3		7.2	5.7	7.2	5.6	6.6	6.4	6.9	7.5	6.3	5.9	5.3	5.7	4.5	5.8	6.6	4.2	5.8	6.2

* Adapted from H. P. Weld and E. R. Danzig, "A Study of the Way in Which a Verdict is Reached by a Jury," *Am. J. Psychol*, 1940, *53*, 529.

called for at the end of each section to be made on a nine-point scale ranging from "not liable" (1) to "liable" (9). Table 75 gives as much of the data of this experiment as space will permit, although the whole of it will repay careful study. The content of the eighteen sections is indicated by a few words at the top of the table, and the steps of the scale are shown on the left. The figures in the body of the table show the distribution of scale scores, whereas the median for each section, with its Q_1 and Q_3, is given at the bottom of the table. The same kind of rise and fall of scores appears here as in the preceding experiment. The personalities of counsel undoubtedly played some part and are probably responsible for the varying influence of the direct and cross examinations of the witnesses. It will be noticed that the cross examination by the defense of the plaintiff's third witness (VIII) actually went against the defense, raising the judgment of liability from 6.2 to 6.4.

THE CONSENSUS OF THE JURY

When the jury begins to deliberate in the jury room there arises a whole series of psychological problems such as the relative validity of the individual's judgments as compared with those of a group, the effect of the elimination of chance errors by combining judgments, the influence of open discussions, and the relative power of different individuals in the group to sway the judgments of others. Some of these points have been discussed at length in Chapter 13 and will not be repeated here. There has been sporadic research in America upon the effect of group discussion since the early work of Münsterberg (*443*), which was followed by that of two of his students, Burtt (*74*) and Marston (*399*). Münsterberg found that group discussion improved individual judgment, Burtt found the effects negligible, and Marston concluded that a single individual might be a better judge of facts than a group. A whole series of experiments conducted by Bechterew and de Lange (*30*) seemed to confirm the conclusions of Münsterberg in that they found that group discussion improved the general quality of judgment, tending particularly to bring the less effective members of the group more nearly to the level of the more effective.

The final stage of the research of Weld and Danzig (*689*) does not throw so much light on the question of jury-group action as might have been expected. Of the three juries with which they worked—two of twelve members each and one of seventeen, making a total of forty-one jurors—only one changed its position after the first vote was taken in the jury room. Shifts of judgment did occur, of course, but only one was great enough to change from a finding for the plaintiff to one for the defendant. There was either a remarkable stability of the judg-

ments formed in the court room or a strong resistance against change in the jury room.

Dashiell (*125*), in a series of several dramatic experiments of the laboratory type, made a variety of comparisons of individual versus group opinions reached after discussion. All of the settings bore some resemblance to the court-room situation, though not so close as in the study of Weld and Danzig.

In general, Dashiell's jurors were asked to reconstruct the story of an event after hearing it recited by two or more witnesses, and either with or without open discussion. They were not called upon to make a decision of "yes" or "no," but to report as many items and with as great accuracy as possible. Dashiell draws the definite conclusion "that a jury-as-a-whole will give a more complete and more accurate account on a definite number of details than an average individual juryman" (*125*, 1140).

All of these experiments that have been mentioned, either through their direct findings or through their conflicting conclusions, emphasize the importance of the individual in determining results. One cannot say categorically that a group opinion will or will not be better than the opinions of the individuals that comprise the group, nor can he say categorically that discussion within a group will raise the quality of the judgment or leave it unchanged. It depends on the composition of the group, particularly as to the degree of prestige or experience of certain of its members and of the level of judgment of those having prestige. Safe estimates of the effects of group discussions such as occur in jury action will depend upon the accumulation of a much larger body of evidence than is now available.

THE PSYCHOLOGY OF THE JUDGE

Evidence is present on every hand that, given a series of objective events, individuals will differ in their interpretation of them. The preceding chapter showed that some of the differences arise in the processes of sensory experience, some in perception, some in memory, and some in judgment. Differences in judgment can be analyzed into more basic conditions, and important among these is the background of experience on which the judgments are made. The less tangible the events are, the greater are the differences in the interpretations of them and probably the larger the part played by individual attitudes, interests, prejudices, and habits of acting and thinking.

The applied psychologist is wholly prepared to find that the opinions and decisions of judges are of the same order as those of the population at large so far as these factors are concerned. The great uproar

that sounded from the citizens of the United States a few years ago at certain proposals to reconstruct the Supreme Court reflected the general expectation that the decisions of that body would be influenced by such a change. The facts presented before the court would not be changed by replacing a few of its members, but interpretation of the facts and the decisions following such interpretations might be expected to change. No systematic studies are known to the writer in which a judge's decisions have been correlated with outstanding and significant events in his biography, but such correlations would undoubtedly be found.

TABLE 76

ESTIMATED SEVERITY OF JUDGES' SENTENCES *

Rating	Judge					
	A	B	C	D	E	F
5—most severe	..	2	20	3	5	..
4	2	4	4	7	4	..
3	9	6	4	4	..	3
2	12	5	..	..	..	8
1—least severe	10	1	..	..	..	17
Number of estimates	33	18	23	14	9	28
Median rank	2.0	3.0	5 0	3 9	4 7	1.3

* From F J Gaudet, "Individual Differences in the Sentencing Tendencies of Judges," *Arch. Psychol.* (New York), 1938, *230*, 49.

There have been studies that show individual differences in the sentencing tendencies of judges as to the kind of punishment and its severity. When the proper controls have been established, as seems to be the case in a few studies at least, the differences can be attributed only to the characteristics of the judge. Gaudet (*203*) found that lawyers have fairly definite notions of the sentencing characteristics of the judges with whom they have to deal. He experienced serious difficulties in employing the questionnaire for getting such information, but he did obtain opinions concerning six judges from a number of lawyers. The number of estimates differed for the various judges, ranging from nine to thirty-six. Gaudet's results are given in Table 76. Although the number of cases is too few to carry much weight, the data probably point to real differences. The judges were ranked for severity of sentence on a scale of 1 to 5, the latter being the most severe. The body of the table gives the number of lawyers giving each judge a given rating. The median rank for each judge is shown at the bottom of the table.

TABLE 77

SENTENCING TENDENCIES OF JUDGES *

Percentage of Those Convicted Who Received a Given Sentence

Judge	*Total Cases*	*Percentage Convicted*	*Suspended Sentence*	*Fine*	*Work House*	*Reformatory*	*Probation*	*City Home, etc.*
1..........	566	99.8	47 6	43 7	6.9	0 2	1.4	0.2
2..........	427	99 5	75 2	8 0	9 6	1 9	3 7	1 6
3..........	156	99.4	27 1	52 9	3.8	0.7	14 8	0 7
4..........	655	99 4	64 0	19 8	11.2	0 9	3.7	0.4
5..........	828	99 3	17 3	62 1	13 1	1 3	5 2	1.0
6..........	123	99.2	59 0	32 0	1 6	4 0	4 5	2 5
7..........	528	99.1	6.1	79.7	11 7	0 2	2 3	..
8..........	530	99.1	59 3	28 5	11 8	..	4.0	..
9..........	650	99 1	81.7	11 1	4 6	..	1.7	0.7
10..........	599	99.0	82 3	6 7	3 4	1 2	1 9	1 6
11..........	552	98.5	77 7	10 1	7 2	0 9	3.5	0.6
12..........	132	98.5	19.2	50 0	30.0	..	..	0.8
13..........	118	98.3	66 3	18 1	9.5	..	2.6	3.5
14..........	176	98.3	68 8	20 8	4.6	1 2	1.7	2.9
15..........	783	98.2	70 4	13 1	16 4	..	..	0 1
16..........	693	98.1	52 4	9 0	26 6	5.1	5.3	1.6
17..........	499	98.0	63 9	17 2	5 9	0 8	10 8	1 4
18..........	207	97.6	5 4	77 8	16.8	..	..	..
19..........	603	97.2	72 7	9 0	16 1	1 5	0.3	0 4
20..........	648	96 9	21 1	65 1	13.4	..	0.2	0 2
21..........	29	96.5	75.0	7 1	10 7	3 6	3 6	..
22..........	690	96.4	36 1	44 5	16 8	0 6	1.4	0 6
23..........	273	96.3	71 5	10.2	16 7	0 8	0 4	0 4
24..........	271	96 3	63 6	16 9	13 8	1.9	2 3	1.5
25..........	494	96 2	32 3	65 9	11 6	..	0 2	..
26..........	101	96 0	22 6	58 8	18 6	..	..	..
27..........	645	95.7	69 9	23 3	3 6	2 6	0.6	..
28..........	136	95.6	71 6	14 6	10 8	..	..	3.0
29..........	403	95.5	34 8	23 3	36 4	3.7	1 3	0.5
30..........	150	94.7	57 7	35.9	5 7	..	0.7	..
31..........	92	94.6	37.8	25 3	35 7	1.2	..	..
32..........	497	94.4	34 3	39 7	25 0	0.6	0 4	..
33..........	204	94.1	70 4	10 4	14 0	3.1	2 1	..
34..........	638	91.1	41 6	14 9	39 5	3.1	0 7	0 2
35..........	67	91.1	57.4	6 6	32 8	1 6	1 6	.
36..........	506	88.1	0 7	61 4	28 1	6.7	0 2	2 9
37..........	667	80.5	36.5	31.1	29.6	2 1	0 5	0.2
38..........	529	78.1	36 6	27 1	32 7	2 2	0 2	1.2
39..........	535	65 5	44.0	26.4	28 7	0.6	0 3	..
40..........	673	21.1	21 1	48 6	27 5	2 1	0 7	.

* Adapted from G Everson, "The Human Element in Justice," *J Crim. Law and Criminol*, 1919-20, *10*, 94-95.

Actual statistical analysis of the sentences imposed by judges has been made in a few instances in order to disclose individual trends. Everson (*165*) studied the sentences imposed by various judges for minor criminal offenses in order to disclose the personal equation in judging, to show, as he put it, that "the warm human attributes of our ministers of justice, our magistrates and our justices, their peculiarities of temperament, their chance prejudices, their warm openheartedness or their petty tyrannies, their leniences or their severities" are not "charmed away by the donning of judicial robes" so as to make the justice they dispense "an abstract thing as immutable as the law of gravitation." Some of his data covering the handling of cases of intoxication by forty different judges are given in Table 77. There is every reason to believe that all the judges received an equivalent sampling of cases, so that the differences that appear are attributed

TABLE 78

SENTENCING TENDENCIES OF JUDGES *

Crime	*Judge*	*Percentage of a Given Type of Sentence*			
		Penal	Suspended	Probation	Fines
Property	A	37 3	32 5	29 6	0 6
	B	57 4	23 1	18 1	1 4
	C	53.3	27 7	19 6	0 4
	D	58.1	17 9	23 8	0 2
	E	43 4	28 9	26 3	1.5
	F	33.9	35 9	29 4	0 9
Property and violence	A	47 2	47 2	5.6	0 0
	B	92 9	4 5	2 6	0.0
	C	82 3	13.9	2 5	1.3
	D	81 3	0 0	18 7	0 0
	E	69 6	21.7	8 7	0 0
	F	36.7	62 5	0.9	0.0
Sex	A	47 8	3.0	47.8	1 5
	B	47.6	11 2	37 8	3 5
	C	52 7	10 9	32 6	3 8
	D	26.0	11.5	62 5	0.0
	E	59 4	5 8	31 9	2.9
	F	33 8	14 3	42 1	9 8
Prohibition	A	13 3	6 7	33.3	46.7
	B	6 0	10.0	52 0	32.0
	C	28.6	5.4	32 1	33 9
	D	3.2	0.0	61 3	35.5
	E	13 3	40 0	33.3	13.3
	F	20.8	18 1	26 4	34.7

* Adapted from F. J. Gaudet, "Individual Differences in the Sentencing Tendencies of Judges," *Arch. Psychol.* (New York), 1938, No. 230, 24-25.

by Everson to the individuality of the judge. The various judges are indicated by a number symbol from 1 to 40. Following each number is the total number of cases of intoxication handled, the percentage convicted, and the distribution of the sentences among suspended sentence, fine, workhouse, reformatory, probation, and miscellaneous. By reading down any column of figures one can see the varied percentage of sentences meted out by the different judges. Thus Judge No. 36, who convicted 88.1 per cent of his cases, gave a suspended sentence to less than 1 per cent, whereas Judge No. 9, who convicted 99.1 per cent of his cases, gave a suspended sentence to 81.7 per cent. The percentage of "fine" sentences varied from 6 per cent to 79 per cent, and probation varied from 0 to 15 per cent.

Gaudet (*203*) investigated the sentencing tendencies of six New Jersey judges for four different classes of crimes. He took especial care to control variables so that the differences could be attributed to the characteristics of the judge. Interesting comparisons can be made throughout Table 78, which gives some of his data. For instance, it appears that Judge B gave penal sentences to 92.9 per cent of the cases involving property and violence, whereas Judge F gave only 36.7 per cent of penal sentences. On the other hand, Judge B gave only 6 per cent of his prohibition cases penal sentences, whereas Judge F gave 20.8 per cent. Judge D gave the largest percentage of penal sentences of all the judges for crimes against property (58.1 per cent), but the smallest for sex crimes (26.0 per cent).

The only bit of evidence concerning the basis for such differences as have been noted above comes from Gaudet, who found the judges to be consistent in their sentencing tendencies over a period of years. This means to him that a judge's sentences are a manifestation of his personality. If they were habits acquired while on the bench there should be a change over the years. It should be possible to accumulate better evidence than this. Biographical data of judges eminent enough to have had their biographies published could be checked against their legal decisions not only as a whole, but at the different chronological or professional stages of their lives. More extended studies, too, could be profitably done on the pattern of that of Gaudet.

31

Treatment of the Offender

The problems of crime prevention discussed in an earlier chapter are very closely related to the problems of punishment and other forms of treatment of the offender, for in modern times, in intention if not in practice, all such methods aim at prevention of further crime and the protection of society from criminal acts (*213*).

The immediate outcome of a psychological attitude toward the treatment of offenders will be the elimination of all notions of retribution that still have a firm hold upon many forms of so-called corrective measures. Furthermore, the individualization of corrective measures according to the needs of the offender will keep pace with the process of individualization in business, industry, education, and in the field of management. In so far as the criminal is found to be intellectually deficient, the corrective, remedial, or protective social measures must be adapted to the degree of the defect. If the deficiency is so severe as to make adaptations to a simplified social environment impossible, the defective should be removed from social situations and prevented from the propagation of his kind. Certainly the threat of capital punishment, torture, prolonged solitary confinement, hard labor, moral suasion, and educational efforts will not change the mental status and the irresponsibility of such defectives. The experiences of the Vineland Training School for Mental Defectives and other similar institutions in their attempts to educate defectives offer sufficient proof of these statements. Where the deficiency is less marked, some form of periodical supervision or some means of providing sufficiently simple social contacts may be adequate. Where the crime is merely evidence of mental illness or some organic degeneration, the individual is entitled to just as careful and competent treatment as a patient suffering from any less dangerous malady.

For the cases that do not fall within these categories, some form of punishment is generally advocated which shall serve as a deterrent from further crime on the part of the individual, as a means of educating him

for more adequate adjustments to life, as an example to deter others from similar acts, and as a temporary protection to society during the regenerative process. It will be recognized that modern punishment methods fall far short of accomplishing all these ends. The function of punishment which is by far the simplest, namely, to deter from further crime, has been and still is the object of active controversy. Does punishment act as a deterrent, and if so, what forms of punishment will be most effective in this respect? These and many other problems of punishment may be approached from the psychological point of view, although the psychological laboratory has relatively little ready-made data to offer. It has still less in the way of laboratory techniques that will be useful for the purpose. The tool of statistics, which the psychologist possesses in common with the social sciences, is at present the most useful instrument at his command.

DETERRENT EFFECTS OF PUNISHMENT

The important position occupied by the deterrent value of punishment in the modern conception of crime is indicated in the following definition (*470,* 540):

> A crime is an act which is adjudged by lawful authority to be so deleterious to the public good as to require it not only to be prohibited, but to require the punishment of those who disobey the prohibition, to the end that, an example having been made, the prohibition will be obeyed

There is a certain psychological justification for punishment as a device for correcting and regulating behavior. In the training of both animals and children punishment for wrong-doing has its place as a companion to reward for correct action (Chapter 4). Out of all the psychological research upon the subject of reward and punishment there emerge three vital rules that must be obeyed to make punishment effective as a corrective device, but which, in the present-day methods of criminal procedure, are especially difficult to apply. They are (1) that the punishment should *invariably* follow the wrong action; (2) that the punishment should occur immediately or very soon after the wrong action; and (3) that the punishment should be so annoying or painful that it will be more desirable to follow the right than the wrong course of action.

In practice all three rules are violated. The punishment not only does not follow invariably but the chances of escaping punishment altogether are too great. This condition is due both to the difficulty of detecting the offender and the difficulty of getting a conviction after detection. Modern inventions such as the automobile, the gun silencer, the electric

metal-burning torch, and high explosives not only render useful service to mankind but offer effective means for the commission of crime and lessen the chances of discovery. The technicalities of the law, originally created for the protection of the innocent, have become, in the hands of unscrupulous lawyers, the means by which the criminal may escape conviction. There seems to be a general understanding among criminals that a delay in the trial of their cases means an advantage to them.

Where conviction is finally obtained, the punishment follows so tardily upon the crime that the deterrent effect is slight upon others than the criminal, and probably also upon him. Both these evils, uncertainty and delay, and some of their causes, are indicated in the following paragraph by Paine (*482*) which describes the diverse agencies responsible for detection, trial, conviction, and punishment of an offender. They have been recognized as factors contributing to increase in crime and steps have been taken especially to speed up the legal machinery in the handling of criminal cases.

The Police Department may arrest a criminal, or it may fail to catch him. It may prepare and present the evidence properly, or it may fail to do so. If the Police Department does not catch the criminal, of course the matter ends. If the Police Department catches the criminal and properly presents the evidence before the Police Court, the Police Judge, or City Judge, binds him over to the Grand Jury. If the City Judge binds over to the Grand Jury, then the Grand Jury may indict or return a not true bill If the Grand Jury fails to return an indictment, that usually ends the case, and two members of the Grand Jury can prevent an indictment. If the Grand Jury indicts, the Prosecuting Attorney usually reviews the evidence and the facts, and sometimes nolle prosses the indictment. If he recommends such procedure, that usually ends the case. If the case goes to trial in the Criminal Court, a jury of twelve men must first be selected, with the attendant delays, if it be a case of major importance. After our best citizens have either disqualified themselves, or been disqualified by reason of our antiquated jury system, the trial is had in the Criminal Court, and one man out of twelve on the jury can cause a mistrial bringing about the usual delay, scattering of witnesses, etc., all of which operates for the benefit of the criminal. Attorneys for the defense interpose all manner of objections in the effort to get the court in error. If the jury finds the defendant not guilty, that, of course, absolutely ends the case. If a mistrial is had, then on a second trial, it is even more difficult to obtain a conviction. If, however, the defendant is found guilty, and, as is the case usually in this county, a minimum sentence is imposed, it goes to the Supreme Court for review. It there passes completely out of the hands of local officials and the State Attorney General presents the case before the Supreme Court, examines the record, and, if errors of procedure appear, the case will be returned for a new trial in the local criminal court with its attendant delays and disadvantages. If, however, the Supreme Court affirms the decision of the usual minimum penalty, the convicted person immediately starts about to get a pardon. His family and friends bring all pressure to bear upon the Governor and the Pardon Board, and if the criminal is pardoned, of course the whole procedure goes for naught.

The deterrent effect of punishment must rest primarily upon the *anticipation* of dissatisfaction, annoyance, discomfort, or pain as a consequence of the forbidden action. The failure clearly to understand the intended purpose of punishment, the confusion of its deterrent function with that of reëducation, or possibly the hope that a given punishment might accomplish both ends, has led to a curious state of affairs. It seems obvious, when the problem is analyzed from the psychological point of view, that a form of treatment whose anticipation will act as a deterrent will not be a form of treatment best adapted for the process of reëducation. Yet the general trend of punishment methods has been away from severity toward leniency, without at the same time raising their reëducational efficiency. Along with the indeterminate sentence, there has gone a tendency to expect the minimal sentence, which may be further reduced for good behavior and useful service. The prison methods, too, have, in many institutions, been radically changed. Work is done under conditions that compare favorably with those outside prison walls. Recreations are frequently available in a form and a degree not enjoyed by free men. Facts such as these are dramatically presented in the following paragraph (*470*):

> In a recent number of the prison magazine at Sing Sing, I observed that during the baseball season just ended the local nine had played over one hundred games with outside visiting nines, viewed by the prison inmates from a concrete grandstand; that during the theatrical season there had been a theatrical performance nearly every Friday evening by various companies, many presenting the best shows running in New York, to see which the unconvicted citizen has to pay five or six dollars a seat; and the movies while away the tedium of almost all of the other nights of the week. The hours of work are much shorter than those of the ordinary working man; and until very recently, if the fastidious palate of any prisoner were offended by the prison fare, he was allowed, if possessed of the price, to buy special food for himself and have it specially cooked and privately served. In the prison at Great Meadow the inmates go forth at a gentlemanly hour in the morning (compared with the ordinary farmhand) to labor unguarded on the farm until an hour not too late unduly to fatigue them, when they return each to a large and commodious cell with a shower in it, where they refresh themselves for the evening meal and evening entertainment. A few have strolled off and never returned, but the management should not feel mortified over its failure to please—there are always, everywhere, some hypercritical individuals who are never satisfied.

The views thus far expressed are not intended as an argument against the newer and more humane prison methods. They are not intended, either, to prove that punishment should be used for its deterrent effect. But if punishment is to be used solely or primarily as a deterrent, then the tendencies toward greater leniency in dealing with prisoners in all respects are psychologically unsound.

EXPERIMENTAL STUDIES OF PUNISHMENT

Just exactly what conditions would be most deterrent could be discovered by properly controlled surveys, although reliable data would be difficult to secure. Two points are clear; first, that it may not be entirely safe to state *a priori* just what the most effective treatment of the offenders would be; and second, that individual differences would appear here as in every case where human behavior is studied. A few years ago, an investigation was conducted among the occupants of the death house of a large prison concerning preference for various kinds of punishment. There was a general condemnation of the death penalty as a punishment device, a result not unexpected under the circumstances. Some, however, considered it preferable to twenty years or more of solitary confinement, as they thought the latter worse than death.

An experiment performed by Hollingworth (*266*) is suggestive for its tentative results in a new field. It suggests the possibility of submitting to experimental inquiry a variety of problems that are usually approached only through vague interpretation of ambiguous historical material or through biased judgment based on incidental and uncontrolled individual opinion. The experiment obviously suffers from the fact that it calls for reaction to a hypothetical situation. The subject is asked to respond "as if" the dilemma were real. Such technique has been frequently employed in getting reactions to advertising, thus: "If you were in need of a fountain pen, which one of these advertisements would be the most convincing to you?" However, the task of the subject in the experiment about to be described is admittedly far more difficult.

The instructions given to each of fifty persons (twenty-five men and twenty-five women) who took part in the experiment were:

Imagine yourself to be on the point of committing some act which is socially and legally regarded as a crime, but which you are determined to perform because of the intense personal satisfaction it will bring you. The only deterrents are the chance of detection and conviction, the magnitude of punishment and the social stigma incurred.

Assume that the penalty in all the different states is a period of imprisonment, which is, however, considerably different in amount in the different states, and that some states are more or less lax in their prosecution of the given offense, while others are exceedingly stringent in their methods of detection and conviction.

Suppose that the nature of the crime permits its commission in any one of these several states, with equal ease and facility as far as you are concerned

Which of these states would you choose first as the place in which you would commit the crime? If you could not select this state, for unavoidable reasons, which would be your next choice? Place the ten states in an order of merit

on this basis—placing first the one you would select first, second the one you would next choose, and so on, until the state in which you would be least likely to commit the crime is at the bottom of the list

Kansas—Imprisonment for life Almost absolute certainty of escape. Only 10 cases out of every 1,000 are detected and convicted.

Idaho—Sixteen years' imprisonment. Chances enormously in favor of escape. Only 30 cases out of every 1,000 detected and convicted.

Montana—Eight years' imprisonment. Chances of escape very high. Only 60 cases out of every 1,000 are detected and convicted.

Wyoming—Four years' imprisonment. Abundant chances of escape. Only 120 out of 1,000 cases are detected and convicted.

Arizona—Two years' imprisonment. Considerable chance of escape. Only 250 out of every 1,000 cases are detected and convicted.

Utah—One year's imprisonment. Chances of escape and punishment are even. 500 out of every 1,000 cases are detected and convicted.

Colorado—Six months' imprisonment. Fair possibilities of escape. 660 out of every 1,000 cases are detected and convicted.

Oregon—Three months' imprisonment. Slight possibility of escape. 850 out of every 1,000 cases are detected and convicted.

Nevada—One month's imprisonment. Bare possibility of escape. 900 out of every 1,000 cases are detected and convicted.

Arkansas—Ten days' imprisonment Absolute certainty of punishment Not a single case escapes detection and conviction.

It will have been observed that in a general way the certainty of conviction increases as the magnitude of the penalty decreases. The reader should perform the experiment, making his own arrangement of the various alternatives and recording them, before reading further, in order to experience the feasibility of the task.

Table 79 shows the way in which the various situations were evaluated. In the column on the left are given the various combinations of magnitude of penalty and certainty of conviction. Along the horizontal head line are indicated the various possible positions, ranging from 1 to 10. To be placed under *10* would mean that the particular combination was felt to constitute the strongest deterrent in the series. The figures in the various columns indicate the percentage of all the observers who placed the given situation at the point indicated. Thus, in the case of the one-year penalty, 10 per cent placed it in first place, 8 per cent in second place, 10 per cent in third, 14 per cent in fourth, 24 per cent in fifth, 28 per cent in sixth, 2 per cent each in seventh, eighth, and ninth, and none in tenth.

In general these fifty people are seen to be made up of two different groups. The small penalties, with high certainties, tend to be placed more often either very high or very low. The larger the penalty and smaller the certainty the more the situation tends to be shifted toward the middle of the range, until the medium penalties (one and two years) are reached. When this medium point is passed the lines divide

TABLE 79

DETERRENT EFFECTS OF CERTAINTY AND MAGNITUDE OF PENALTY

Penalty	Distribution of Judgments									
	1	2	3	4	5	6	7	8	9	10
10 days 1,000 certain	16	2	6	6	18	14	4	4	12	18
1 month 900 certain	8	26	4	8	4	8	6	10	24	2
3 months 750 certain	2	6	30	10	6	10	6	26	2	2
6 months 660 certain	8	14	10	22	16	0	28	2	0	0
1 year 500 certain	10	8	10	14	24	28	2	2	2	0
2 years 250 certain .	8	4	12	8	32	28	0	0	2	6
4 years 120 certain.	6	12	4	24	8	6	32	4	4	0
8 years 60 certain..	8	6	18	2	6	8	8	42	2	0
16 years 30 certain..	1	18	2	2	2	8	10	4	46	2
Life 10 certain..	16	4	2	4	2	4	2	2	6	58

again, and the larger numbers occur closer and closer to the extreme position.

Now if the various situations were equally deterrent, we might have expected the same distribution of positions in all cases. If for all members of the group the larger penalties and the larger certainties were more deterrent we might have expected a single line, shifting from one extreme toward the center, then back again. If only penalty or only certainty were the crucial determinant, we might have expected one line of plurality choices, marching either one or the other way across the table.

But none of these results occurs. Instead, there is one group of people for whom the penalty is the determining factor and another for whom the certainty is the chief deterrent. For both groups the average penalties and average certainties have only average deterrent strength. One group is inclined to take the large chances of escape, risking the large penalty. The other group shows no inclination to gamble, preferring to accept the high probability of a small penalty. What individuals comprise these two groups the table does not show. The reader who may suggest that the men make up one group and the women the other is, however, in the wrong. The men and women react in the same

way, and both show the division into two rather distinct groups with small numbers of individuals occupying the gaps between.

If each time a situation is placed in 10th, 9th, 8th, or 7th, etc., position it be credited with 10, 9, 8, or 7, etc., points respectively, and the total points computed for each situation, the values shown in Table 80 result. The larger the score the greater will be the deterrent effect on the total group of observers.

These results show that the extremes, either of penalty or of certainty, are judged to have the stronger deterrent effect on the group as a whole, the average degrees of each being relatively weak. Penalties of eight years or more, even with high probabilities of escape, are definitely judged more deterrent than penalties of three months or less, with almost absolute certainty of conviction.

TABLE 80

ORDER OF DETERRENT VALUE OF PUNISHMENTS

Situation	*Score*	*Order of Strength*
10 days, 1,000 certain	292	3
1 month, 900 certain	265	5
3 months, 750 certain	261	6
6 months, 660 certain	223	10
1 year, 500 certain	224	9
2 years, 250 certain	244	8
4 years, 120 certain	253	7
8 years, 60 certain	285	4
16 years, 30 certain	331	2
Life, 10 certain	372	1

A somewhat similar experiment (*151*) offering five choices to 200 men and women brought results resembling those just quoted. The alternatives to be arranged in order of preference were:

Judge A who always gives one year in jail, but only 20 per cent are convicted.
Judge B who always gives six months in jail, but 40 per cent are convicted.
Judge C who always gives three months in jail, but 60 per cent are convicted.
Judge D who always gives one month in jail, but 80 per cent are convicted.
Judge E who always gives ten days in jail, but 100 per cent are convicted.

Table 81, giving the results for the 200 persons, is to be interpreted in the same way as Table 79, except that the least certainty is at the top of the table instead of at the bottom. Judge A, who offers the greatest chance of escape, is the favorite, although there is a fairly large number who prefer the lightest sentence with certainty of receiving it. Such differences as appear in the two experiments are, doubtless, due to the more restricted range and greater leniency of the punishment

and to real variations among individuals in the willingness to take a chance or gamble, and show up equally in other life situations.

In connection with the second experiment, it was intended to make a survey of prisoners' opinions, but the conditions were found to be such that the data obtained from them would probably be worthless. The numerous difficulties, complications, objections, and sources of error that beset such inquiries in legal and criminal psychology are obvious. These need not be rehearsed here, although the inquiring student may well consider them inasmuch as each raises to consciousness a further problem that might itself be investigated by some such procedure as that followed here. In this field, as in many others, the mere raising of problems to consciousness and their preliminary attack by methods however inadequate may constitute a significant contribution.

TABLE 81

Choice of Punishment *

	1	*2*	*3*	*4*	*5*
Judge A	49	13	6.5	11	20.5
Judge B	6	35	23	25	11
Judge C	2	14.5	56	19.5	8
Judge D	12.5	23	10.5	39	15
Judge E	30.5	16	5	2.5	46

* From J S Durham, *Certainty versus Severity of Punishment,* Unpublished Master's Thesis, Columbia University, New York, 1925.

Opinions expressed by a number of heads of penal institutions were unanimous that a greater deterrent effect upon most offenders would be secured by increased certainty than by increased severity of punishment. The following by a chairman of a State Penal Code Commission will serve as a sample of them:

> I believe the greatest deterrent to crime is a quick trial and positive punishment, no matter what the amount of punishment would be. It is the one fact that criminals seem to know, that they can be arrested, enter bail, and have the date of their reckoning deferred indefinitely, which encourages them to continue in their evil ways. The certainty that one would be tried and punished immediately, no matter whether he entered bail or not, in my judgment, would help the cause of justice immensely.

Actual surveys of the effects of specific kinds of punishment are relatively infrequent. They are necessarily difficult to make, because of the large numbers of uncontrolled variables that enter into the final result of punishment. The studies that have been reported give slight support to the belief in the efficacy of punishment. Flogging affords a striking case to investigate because the primary reason, if not the sole

reason, for its use resides in its supposed deterrent value. A statistical survey of the relationship between the number of floggings for robbery with violence and the volume of robbery with violence in England over a period of seventy-three years has been made by Lewis-Faning (*376*). He found no relation at all between the number of floggings in a given year and the amount of crime in the same, the preceding, or the following year. He concluded that flogging in no way acts as a deterrent, but strangely suspects that the practice is retained for its retributive effect.

REEDUCATION OF THE CRIMINAL

Two facts about the treatment of offenders remain for consideration, namely, their reconstruction and the social defense against them. Decision must be made in every case as to whether reëducation is feasible. If it is, then the individual will need to be segregated only during the reconstruction process. If, however, it is not feasible, provision must be made for permanent segregation and the prevention of procreation. In the case of feeble-minded persons, who are at the same time vicious, and in the case of certain kinds of degenerates, permanent segregation seems to be the only proper course of treatment. The conception of treatment as a form of punishment should be eliminated, and methods of treatment should be chosen on the basis of such facts as security, economy, and comfort. The failure to make an adequate diagnosis of criminal cases to determine which are and which are not reclaimable has led to the failure of notable attempts to apply modern methods in criminology.

The problem of education is an extremely difficult one, even where it is feasible. In most instances the persons are adults and, therefore, have passed the period when intellectual, social, and moral habits are most easily inculcated. The difficulty is further increased because it is necessary not only to establish correct habits and correct attitudes toward social situations, but distorted ideas must be eradicated, antisocial attitudes must be corrected, and disrespect for law must be changed into respect for it. The greatest insight into human nature, skill in dealing with it, and an unlimited amount of patience would seem to be necessary for those whose duty is to educate the criminal. All these matters must be cared for while providing the individual with a means of earning an honest livelihood. Such facilities can scarcely be hoped for in an institution where the concept of punishment plays a dominant rôle. The prison system, where the more radical reforms have not touched it, represses the very natural tendencies that are ordinarily played upon in the educational process. Of first importance among these, perhaps, is the tendency toward social intercourse, which is re-

duced to the minimum in prison life. Such associations as do occur are among those who are likely to exert an evil rather than a beneficial influence. Added to this is the fact that most associations among the inmates of prisons must be carried on surreptitiously and at the risk of severe punishment. This tends to exaggerate the disrespect for authority and to foster a criminal cunning in outwitting it.

A psychologically sound system for the treatment of offenders may be suggested as a result of the preceding discussion. It would rest upon the conception of the individual as the unit to be dealt with. Each case should be analyzed and classified on the basis of a study of immediate ancestry and personal history, including environment, education, character of associates, the nature of the offense, and motives leading to it. A twofold classification should be made into (1) those who cannot be reclaimed because of insanity, feeble-mindedness, or too long a career of crime; and (2) those who can be reclaimed because of their youth, their intelligence, and the nature of their offense. Insane hospitals, institutions for the feeble-minded, and penitentiaries should be provided for those of the first group; industrial colonies and reform schools should be provided for those of the second group, with the adoption of the indeterminate sentence, parole, or suspended sentence. For all cases there should be the maximal degree of certainty of detection that is possible to attain, together with the decision without delay concerning the treatment to be administered. A rigidity of discipline should be guaranteed that will be compatible with the progress of reform and, while free from the atmosphere of punishment, still carry with it a deterrent value that cannot fail to be appreciated. Such a comprehensive plan is impossible today because of the obstacles to an adequate analysis of the individual and because of the inadequacy of the machinery of the law and of the penal institutions. But the adoption of the point of view that a criminal is a psychological problem to be studied, and the recognition of how far the current systems of punishment fall short of such a point of view, are the first steps necessary to the gradual evolution of the penal system toward the ideal both for society and for the individual.

PAROLE AND THE PREDICTION OF ITS RESULTS

Great uncertainty exists in regard to the effects of the many and various methods that have been proposed and tried out for the rehabilitation of criminals. Not only are the variables usually numerous and beyond control, but measures of the success of treatment are lacking in most instances. Hope, desire, and prestige are usually more powerful determiners of the status of any program than is measurable objective

evidence. A notable exception is to be found in the device of parole. The set-up of the parole program, at least the best instances of it, with its careful study of the cases before parole and the close follow-up after release, makes possible the measurement of its success and failure and even of degree of success and failure. Advantage has been taken of the opportunities for measurement, particularly by the sociologists. There are many psychological problems, also, to be met in the analysis of the conditions that make for successful or unsuccessful parole, and these have scarcely been touched.

The research of Laune (*366*) on the forecasting of behavior on parole furnishes an excellent introduction to the problem of parole and to the technique for measuring the factors that make for successful parole. This is a study of prediction of the outcome of parole by a combination of the case-study and the actuarial methods described in Chapter 28. Prediction in this instance calls for a criterion of success or failure of parole, and a series of items to be checked against the criterion. For the purpose of this study, successful parole means final discharge from parole, the maximal sentence having expired before the issuance of any warrant charging violation, or death before the issuance of such a warrant. Failure means being declared a violator, with the issuance of a warrant for arrest, or being killed in the act of committing a crime.

Fifty-four behavior factors were derived mainly from the study of case histories. These were classifiable into five large groups as follows: (1) psychological and physical factors, such as intelligence, pleasing personality, lack of conceit; (2) factors connected with industry, such as working ability and work record; (3) factors connected with "high life," such as sex craving, and desire for clothes; (4) factors connected with family, such as being happily married and with good environment; (5) factors connected with criminal record, such as recidivism and gangster status. The original fifty-four factors were analyzed first into 1,701 items, which by factor-analysis technique were reduced to 161. These were arranged in the form of a questionnaire calling for a "yes" or "no" response (*366*, Appendix G). This questionnaire has at present reached the stage where it is being validated by check against a criterion group. It should be noted that the parole program makes it possible to check the predictions that are made before parole, rather than to work backward from questionnaire records obtained after successful or unsuccessful parole. With the exercise of ingenuity it should be possible to adapt this parole measuring technique to the evaluation of other methods of treating the criminal.

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The Prevention of Disease

The affiliation of psychology and medicine has always been especially close. Many of the older and best known psychologists had previously been physiologists and some of them had been physicians. Much psychological work, too, has been done by medical investigators. Evidence of this relationship in the early days of psychology as a science is to be found in Lotze's *Medicinische Psychologie* and Tuke's *Dictionary of Psychological Medicine.* More recently, many of the books on abnormal psychology have been written by medical men, such as Janet, Coriat, Sidis, and Freud. On the other hand, numerous psychological methods have been taken over by medicine, and books on physiological problems, especially physiological psychology, have been written by psychologists. In France there has been a common interest on the part of physicians and psychologists in abnormal mental phenomena.

In the course of the specialization of training made inevitable by the expansion of the fields of psychology and medicine, there has developed a series of special disciplines called psychopathology, medico-psychology, psychiatry, psychotherapy, orthopsychiatry, psychosomatic medicine, and clinical psychology, which occupy the territory lying between psychology and medicine. Even the newest of these specialties have grown to the point where they have their own scientific journals. There is, for instance, the *Journal of Orthopsychiatry,* and *Psychosomatic Medicine,* the latter accompanied also by the *Psychosomatic Medicine Monographs.* Men and women are being trained for work in these intermediate fields and are being appointed to research and clinical positions in connection with many of the leading hospitals. All these facts indicate that psychology and medicine are, in part at least, joint tenants of a common ground of content and method.

The failure of psychology and medicine to establish far closer relationships has been the subject of critical comment particularly during the last two decades. The responsibility for the lack of a joint attack upon many problems that would obviously profit thereby has been laid

at times upon medicine and at times upon psychology (*451*), and numerous remedies have been proposed. These remedies vary all the way from the introduction of courses in psychology into the medical-school curriculum to the organization of a new discipline (*503*) and the setting up of a new institution for public service. Harrington (*242*) envisages such a school to serve the following purposes: first, to teach the art of normal living or self-guidance in meeting the personal and social problems inevitable in an imperfect world; second, to promote mutual understanding and coöperative effort between psychologists, physicians, educators, sociologists, and others who are professionally interested in the cause of mental health; and third, to serve the needs of the medical profession by providing a more adequate and less costly form of mental therapy than the practicing physician is able to obtain for his patients at the present time.

RELATIONSHIP BETWEEN PSYCHOLOGICAL AND PHYSIOLOGICAL REACTIONS

The search for causes of disease and for preventive measures against it is certain sooner or later to focus attention upon the old philosophical problems of the relationship between the mind and the body. Although this puzzling problem will, doubtless, forever defy solution, it is necessary to seek that working hypothesis which will be least likely to impede progress in the understanding of disease.

The common-sense theory, so-called because it seems to the layman to fit the facts best, is technically known as "interaction." According to this conception, the mind and the body are separate entities, each being subject to the influence of the other. It is a matter of almost universal experience that a severe fright or a fit of anger will upset the digestion, and it is equally well known that a heavy meal eaten late at night will cause bad dreams or wakefulness. Instances of this sort could be furnished in great number to show "that mental states affect the body and that bodily changes affect the mind." This conception of interaction has provided an excellent foundation for a great variety of theories of mental healing that range from the plausible to the absurd.

There are certain serious objections to the interaction theory from the scientific point of view. An alternative concept that is more commonly adopted in scientific work, but that leaves many things unexplained, is known as "psychophysical parallelism." It assumes that whenever a certain mental event occurs, a certain physiological reaction takes place, and vice versa, although neither one is the antecedent or cause of the other. The classical philosophical theories that go by the names of "interaction" and "psychophysical parallelism," as well

as others that are not so well known, are discussed at length in *Body and Mind* by William McDougall (*405*), who was the most eminent of modern scientists to champion the first of these. Recent interpretations of particular interest to psychologists have been propounded by Hollingworth (*277*), Boring (*54*), and Woodworth (*709, 22-23*).

As a working hypothesis for psychotherapeutic methods, another point of view may be conveniently taken that will seem as plausible to the layman as the interaction theory, and more so than parallelism. According to this view, a stimulus will cause the organism to respond and this response may be thought of as comprising both mental and physical reactions. There need be no question whether what occurred in the mind affected the body or whether what occurred in the body affected the mind. Sometimes there is very little in the reaction that can be called mental and sometimes there is much The perception of a lemon (mental response) after one has experienced the taste of lemons will cause a violent reaction of the salivary glands (physiological reaction). The cause of the salivary reaction is not the perception, but the cause of the perceptual reaction as well as of the salivary reaction is the physical object, the lemon.

It is interesting to observe that the reaction just described, and recognizable by any student of psychology as a conditioned response, is considered by the physiologist to be a physiological phenomenon (*488*) and by the psychologist to be a psychological phenomenon (*258*). Interest may be concentrated upon either the mental or the physiological aspect of the total response and within limitations the one may be taken as the symptom of the other. But when it comes to prevention, diagnosis, or treatment of disease, it is no longer adequate to rely upon either the mental or the physical reaction as the symptom, but it is necessary to seek the real causes underlying both sorts of symptoms. A micro-organism may cause both the changes in the pupillary reactions and the feelings of grandeur peculiar to general paralysis. The treatment that will reduce the physical symptoms will also reduce the mental symptoms, but only because it attacks the common cause of the two. One may take as a basis for psychotherapeutics, therefore, the view that the behavior of the organism as a whole or of any of its parts can be influenced by stimulation of the special senses, as well as by the administration of medicines (*149*) (*338*).

THE PREVENTION OF DISEASE

There is a growing tendency in medicine, as in the law, to direct attention to preventive measures, to stimulate effort to "keep well" rather than to "get well." Just as in the law, this represents the cul-

mination of a long history, in which interest was first directed at treatment, and mainly treatment of symptoms. With the growth of scientific method, diagnosis began to take its place in medicine, and specialists in diagnosis flourished along with the specialists in treatment. The science of prevention had to wait necessarily for the growth of knowledge of causes, so that preventive measures could be intelligently applied. But the knowledge of causes is not alone sufficient to guarantee the success of preventive medicine. The preventive measures must be adopted by the individual and in most cases must be adopted voluntarily. The resistance that the proposal of methods of prevention meets, even among intelligent people, opens an interesting series of problems which psychology can help to solve.

There are two ways in which psychology may be applied to the problems of the prevention of disease: first, in overcoming the resistances to preventive measures in general; and second, in preventing those diseases which are peculiarly mental in character.

OVERCOMING RESISTANCE TO PREVENTIVE MEASURES

Preventive medicine for the individual, as conceived at present, would involve the institution of periodical medical examinations and the prescription, on the basis of these examinations, of such habits of living as will keep the human machine functioning normally. It recognizes the fact that most, if not all, diseases, especially the more insidious diseases, can be effectually dealt with if discovered at a sufficiently early stage of their development. The function of preventive medicine, then, is to see that the individual takes these necessary steps to insure health.

Theoretically, there would seem to be no serious problem here. In every comprehensive list of native tendencies will be found one or a group called "self-preservation" or "self-protection." They manifest themselves in such mechanical reactions as putting out the hands when falling, and in more complicated ones leading to the relief of pain and discomfort. It is, however, a characteristic of such reactions that they are not far-seeing, but are rather reactions toward immediate relief. The case of the individual who goes to the dentist for the relief of the pain of a toothache will serve as an example. If, on the way, his attention is so diverted that the pain disappears, he may, if he is an average human being, return home because he is no longer in need of the services of the dentist. The protective reaction has ceased with the disappearance of the pain. Every medical practitioner is familiar with cases of a similar sort. If, as a preliminary to the treat-

ment of a serious and painful disease, something is done to relieve the pain, the patient may not return, even though the serious condition underlying the pain may have been fully explained to him. The immediate need for assistance has passed. In a state of nature such as that in which native tendencies probably developed, such reactions would be adequate for the preservation of the species. Now, however, preventive medicine implies a more far-seeing reaction for the welfare of the individual.

It is not difficult to discover that the lack of an immediate emergency is the cause of lack of interest. Experimental health centers supported largely by private funds and calling for only a slight fee from the individual have frequently failed, because the individual who is in good health sees no reason why he should pay even a small amount of money for the protection of himself or his family against the probability of sickness. The remoteness of the emergency offers the chief sources of resistance against all life, health, and accident insurance propositions. A useful aid in selling these commodities is frequently found by giving them an immediate force in the form of their value as an investment or of their borrowing privileges.

A much more serious resistance, but of the same nature, is encountered in the sale of burial plots and in the service of trust companies which make wills and provide for the care of estates. Nothing is more inevitable than death and nothing is so uncertain as the tenure of life, and yet provisions against the emergency are notoriously neglected.

> The atrocities of life become "like a tale of little meaning though the words are strong"; we doubt if anything like *us* ever really was within the tiger's jaws, and conclude that the horrors we hear of are but a sort of painted tapestry for the chambers in which we lie so comfortably at peace with ourselves and with the world.

Almost incredible illustrations of the failure to take precautions against supposedly remote danger may be found in the emergency of war. It is reported that a few days of respite from bombings makes the enforcement of safety precautions so difficult that heavy penalties have to be applied for their violation. The recurrence of danger recently so keenly appreciated seems too remote to warrant the discomfort and inconvenience that self-protection entails.

This indifference to seemingly remote eventualities is curiously complicated by another tendency which might seem to offset it, but which actually reinforces it, namely, the fear associated with the idea of accident, injury, disease, and death. Fear induces a kind of negative attitude in which the person refuses to consider possibilities of harm. It

is almost impossible to force the attention of a healthy person upon such topics for more than a moment. Generally speaking, this oblivis-cence of the disagreeable in one's past and a profound optimism for his future are desirable characteristics, although they do work to his dis-advantage in special cases. Just as the resistance to making a will or buying a burial plot is compounded of an indifference to what is re-mote and a negative attitude toward the unpleasant, so the resistance to health-protecting measures has in it something of the refusal to contemplate unpleasant events as well as indifference to them. It is not at all uncommon to find persons who will refuse to undergo a medical examination for fear it will disclose some disability, and who will say that, if anything is amiss, they prefer not to know about it. Less common, but not rare, are the cases where persons will actually and wilfully withhold information necessary for the adequate diagnosis in the course of an examination which they have requested and for which they are paying a fee. It may be amazing to the uninitiated, but it is well known to practicing physicians that one can derive comfort from a diagnosis made false by his own deliberate deception. The skilful physician learns to detect such peculiar behavior and by inspir-ing confidence in his patient, to overcome it. The portion of an adver-tisement reproduced in Figure 111 strikes directly at these curious tendencies.

PREVENTION THROUGH EDUCATION

How may this indifference and fear be overcome? The same methods of education and promotion must be employed as are found effective for other purposes. The problem is largely a matter of salesmanship, in which disease-prevention is the commodity for sale. As it is a propo-sition of mass selling, advertising methods may be resorted to with advantage. The splendid publicity programs of the great insurance com-panies, of the Public Health Service, of the Commission for the Con-trol of Cancer, and of many other institutions of a similar character employ the newspaper, the magazine, the radio, and the motion picture for broadcasting information to the public (Figure 112). Their success in arousing interest in disease prevention affords a good example of what may be done by applying modern selling methods to the dis-semination of an idea. The following paragraphs, taken from one of a series of health advertisements, show how parental affection may be appealed to in the promotion of preventive measures.

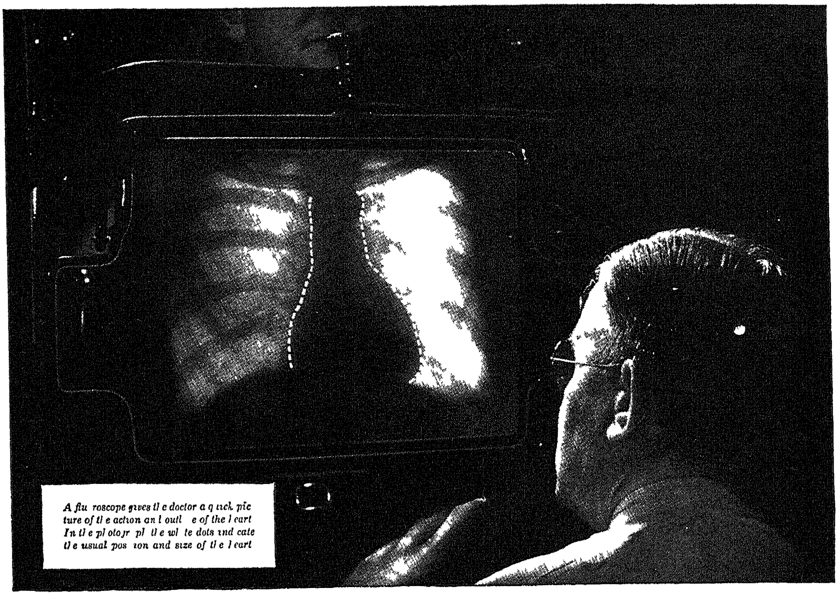
> The business of being a parent is difficult at best. There are days when everything seems to go wrong—days when the children are so exasperating that you forget what they really mean to you.

FIGURE 111

HOW PREVENTION OF DISEASE IS BEING SOLD

FIGURE 112

Selling the Prevention of Heart Disease



A fluoroscope gives the doctor a quick picture of the action and outline of the heart. In the photograph the white dots indicate the usual position and size of the heart.

Your Heart in Action

YOUR newspaper constantly records sudden deaths from heart attacks. Frequently the victims are in the prime of life enjoying happy, successful careers—yet they die too soon. Why?

In thousands of cases the victim was unaware that he had heart trouble. Or he may have failed to heed warnings which would have been plain to a doctor. In still other instances he ignored his doctor's orders to slow down on work and exercise.

The person who knows he has heart trouble is likely to live longer than the one who doesn't suspect it. It is the man who does not know or mistakes the symptoms who is in real danger.

Several common symptoms may indicate heart disease but only a physician can decide whether or not they are serious. Indigestion may be a cloak for an impaired heart. Shortness of breath, pounding or fluttering of the heart may be due to nervousness or overwork, or they may be caused by trouble in the heart itself. Irregularities of the heart's beat, pain near the heart, or pains in the arms and armpits may indicate that something is wrong with the heart, or they may be of little importance. Any of these symptoms calls for an early and thorough examination by a physician.

Today physicians know more about diseases of the heart and are better equipped to diagnose and treat them than ever before. When advisable your doctor may employ the X ray and the electrocardiograph and other modern devices to determine the condition of your heart. Give him a chance to help you.

Modern medical skill has enabled thousands of men and women with damaged or weakened hearts to lead useful active lives, because they know what their hearts can and cannot endure.

You can do much to help keep your heart healthy. A postcard will bring you a free copy of the Metropolitan's new booklet "Protecting Your Heart"—or mail this coupon.

METROPOLITAN LIFE INSURANCE CO. Dept. 1138-X.
1 Madison Avenue, New York, N. Y.

Please send me, without charge or obligation, your new booklet "Protecting Your Heart."

NAME ____________________

ADDRESS ____________________

CITY ____________________ STATE ____________

METROPOLITAN LIFE INSURANCE COMPANY

FREDERICK H. ECKER, CHAIRMAN OF THE BOARD — ONE MADISON AVENUE, NEW YORK, N. Y. — LEROY A. LINCOLN, PRESIDENT

But at night, when you steal quietly in for a last good-night look, how like blossoms they seem—exquisite promises of the future. You dream of the things you hope to do for them—of the advantages you wish to give them—of the gifts you would like to lavish upon them But has it occurred to you that there is something else that perhaps you should be doing for them right now?

Today—before it is too late—use the great gifts of modern medical science to protect your children from disease and to help them become strong and healthy men and women—physically, mentally, and morally. Many deadly diseases can be prevented by vaccination or inoculation. Do not risk the blighting of a single blossom.

The aim should be, so far as possible, to engender immediate and positive rather than negative and remote interests, such as increasing earning power, athletic build, or healthful appearance, rather than picturing what may happen at the age of sixty years. There is evidence of success from such educational methods not only in the statistics of insurance companies but in the increasing degree to which preventive measures are being adopted in the care of the teeth and eyes. Periodic examination of these has come to be the rule among intelligent people. Advertising has had much to do with this. Periodic examinations of the body as a whole, however, are not so common among the well-to-do classes to whom most of the health advertising has been directed thus far, both by virtue of its general tone and the mediums in which it appears.

When purely educational measures are not effective, force may be used to advantage. The fact that it is ever necessary to enforce regulations concerning the use of common drinking cups, common towels, and concerning quarantine against communicable diseases, shows the indifference of the public to the danger of contracting disease and the need for drastic rules with penalties for their violation until the more subtle forms of education shall have accomplished their purpose.

There is one criticism sometimes offered against preventive medicine that deserves notice because of its psychological implications. It refers to the danger that attends the concentration of attention upon one's health. Even in the most sophisticated persons, an examination creates some perturbation, and in highly suggestible persons it may initiate an introspective attitude and entail a long chain of imaginary complaints. It has been said that medical students, in the course of their training, suffer in imagination all the diseases whose symptoms they study. Ill effects of this nature resulting from periodic health examinations will be relatively few and are scarcely to be weighed against the greater benefits that will accrue from a widespread adoption of the practice.

In the broader health movements, such as the eugenics movement for the prevention of inheritable diseases, as well as in the projects of the Public Health Service for the elimination of certain diseases from

large geographical areas, the psychological principles underlying education will play an important part. No measures of this nature can be successful without the acceptance of the idea and its support by individuals. The annihilation of yellow fever required not only the drainage of large areas infested with the mosquito, but the education of the people to protect themselves adequately against attack from those insects that survived. All the devices of education supplementing those of the laboratory will be necessary to eradicate syphilis, tuberculosis, and the common cold.

THE PREVENTION OF MENTAL DISTURBANCES

The function of psychology in the prevention of disease thus far discussed has been as an accessory to other agencies. Attention has been directed to the problem of gaining acceptance for a new idea, rather than to the discovery of the actual causes of diseases or of the preventive measures to be introduced. It was shown that the acceptance of this new idea involves the breaking down of resistance offered by indifference and fear, and the creation of new attitudes of foresight and provision for the future. A different and more vital application of psychology and its methods is possible in the prevention of mental disabilities through discovering their causes, through eliminating them, or through making them innocuous. Consideration will be confined to the prevention of the so-called functional disorders. Those with a definite origin in organic deterioration and in other physical conditions are equally important but are outside the province of the present work.

Amidst the great variety of theories concerning the causes of mental disorder, there stands out clearly as a common element the concept of the maladjustment of the individual to the conditions of his life (*692*). It is inherent in the theory of Freud, of Jung, of Adler, and of Janet, and in the more strictly psychological interpretations. The theories differ mainly in the supposed causes of the maladjustment and the preventive and corrective measures that are recommended.

HEREDITY AS A CAUSE OF MALADJUSTMENT

Heredity occupies a prominent place as a causal factor. The individual is born with certain inadequacies that definitely handicap him in the struggle for existence. The defects of intellect are best known and have contributed largely to the popularity of the hereditary concept, since it is easy to pass by analogy from this defect to the assumption of other forms of deficiency. The "low psychological tension" of Janet (*315*), with its hereditary predisposition, will serve as another

illustration of a natural characteristic that would tend toward maladjustment.

It is not necessary to assume that persons are born with insanities, neuroses, or psychoses, but that their natural inadequacies become exaggerated and develop into them. On the other hand, they may remain mere deficiencies, if proper protective measures are adopted. As Münsterberg (*445*, 77) said many years ago:

> Every one knows persons whose pessimistic temperament makes them inclined to an over-frequent depression, or others whose silly disposition brings out constantly those emotional tendencies which the maniac shows in an exaggerated degree. The stupid mind shows those lacks of association and connection which reach their maximum degree in the mind of the idiot. We know from daily life the timid, undecided man who cannot come to a will impulse; the hasty man who rushes toward decisions, the inattentive man who can never focus his consciousness; and the over-attentive man who can never dismiss any subject; the indifferent man on whom nothing produces evident impression and feeling; the over-sensitive man who reacts on slight impressions with exaggerated emotion; and yet every one of such and a thousand similar variations, needs only the projection on a larger scale to demonstrate a mental life which is self-destructive. The silly girl and the stupid boy, the man who has the blues and the reckless creature, are certainly worse equipped for the struggles of existence than those who are intellectually and emotionally and volitionally well-balanced.

Here are displayed in miniature all the mental diseases. They are still within the realm of normality but circumstances that are too complicated, too rapidly changing, or too difficult may distort them into disease.

ENVIRONMENTAL FACTORS IN MALADJUSTMENT

The part played by the environment, both physical and social, as a causal factor in mental disease is evident in the hereditary interpretation. But it is frequently made to serve a more dominant rôle. Thus Patrick (*487*, 16), in advocating the need for a gospel of relaxation, said,

> It is very probable that our modern strenuous life is bringing too heavy a strain upon the brain, particularly those parts of the brain immediately connected with the mental powers which condition that peculiar kind of progress which the world is now making. The tendency of the times is toward a very swift industrial, commercial, professional and intellectual activity. It is an age of great effort and endeavor, of stress and tension, of labor and strain, of scientific and inventive ability; an age of great efficiency and striving for efficiency; an age of variegation; a centrifugal age. It is not an age of peace and calm, of poise, of relaxation, of repose, of measure, of harmony, of conservation.

The results of life under such conditions are likely to be a rapid and extreme exhaustion of the nervous system and an insistent demand for

rest and relaxation. But the organization of modern social life does not provide the natural means of attaining rest and relaxation, with the result that artificial means may be resorted to, such as tobacco, alcohol, and drugs. Such a combination of circumstances leads to a long train of mental ills in individuals who would be normal under easier conditions. The first World War offered a multitude of illustrations of the consequences of unusual demands upon the individual. "Shell shock" and a great variety of psychoneurotic manifestations developed in persons who were capable of a normal life in times of peace, but who broke under the strain, worry, overwork, and too sudden shifts in mode of life.

Environmental influences of the sort described take on added significance since it has been demonstrated that they can be the cause of somatic diseases. The literature of psychosomatic medicine is filled with case histories showing the organic effects of situations that arouse strong emotions (*149*). Deutsch (*132*) describes in detail two severe cases of asthma which had an emotional origin. More interesting to the psychologist, perhaps, are the cases of stomach (*147*) and intestinal ulcers that are traced to "emotional" causes (*702*). He will be prepared, from his familiarity with the work of Cannon (*78*), to understand the effect of emotional states upon the gastric and intestinal secretions. Changes in the quantity or composition of these secretions may cause irritation which, if long continued, will lead to ulceration.

THE RESPONSIBILITY OF EDUCATION FOR MALADJUSTMENTS

A third view attributes the great increase in nervous and mental disorders not to hereditary inadequacies nor to the conditions of life that are acknowledged to be rapidly increasing in difficulty and complexity, but rather to a failure of our modern system of education to prepare youth to meet these conditions squarely. Münsterberg attacked particularly the principle of freedom in educational methods and the dependence upon interest as a spur to activity, in that it does not furnish a sufficiently rigid discipline and does not train individuals to attack and conquer obstacles that they will inevitably meet. A child who, throughout his school years, does only what he wants to do, what he is interested in, or what is fun, cannot adjust himself to the hard knocks, the unpleasant tasks, or the long hours of routine that await every adult in the everyday world. It is difficult, indeed, to evaluate such an interpretation. The fact of an increase in nervous and mental affliction upon which this interpretation rests might be questioned as the data available are not entirely unequivocal. Then, too, it should

be remembered that educational techniques can be skilfully or stupidly employed. In defense of the appeal to interest, one must remember that a child can become interested in doing the hard things rather than the easy things, in looking to the more remote and lasting satisfactions rather than to immediate and more trivial pleasures (*135*). Furthermore, the concept of freedom in education has been in force for too short a period to demonstrate its effects. More than one or two generations will be necessary to measure them adequately.

A remarkable letter, which appeared in Link's (*380*, 108-111) *The Return to Religion*, is a splendid illustration of an attempt, perhaps too late, to correct an early-formed attitude toward life which was demonstrated by the desire for *immediate fun.* Although the letter is too long to be reproduced here, it should be read by every serious student of psychotherapy.

PRACTICAL MEANS OF PREVENTING MALADJUSTMENTS

It would appear from what has just been said about education in the early years of life that the one overall preventive against mild or serious personality maladjustments is training to meet rather than to shirk the problems and difficulties that every person is certain to encounter. If one word were to be chosen to denote the aim of such training it could be "self-reliance." Morgan (*438*, 13-29) pointed out that the reason economic stress, emotional crises, and sudden and exceptional responsibilities are so often the cause of initial breakdown is that the individual from his earliest years has been shielded from every such episode. He advocates a gradual exposure to obstacles that are carefully adjusted in magnitude. Temporary failures are signals that the child needs a little more protection for the time being. At the same time, he needs more strength so that, at some later time, he will be able to stand up against a situation that now is too much for him. Morgan believes that for the properly trained child there are no "great" crises. Such a child has learned to face difficulties of increasing severity so that when a major crisis arises he will face it "without realizing that he is doing anything heroic." Early seasoning of one child to hardship has been known to enable her to survive without fear for four days when lost in the woods with nothing to protect or support her except what nature afforded. That was no crisis in her life, it was merely an occasion when she needed to take care of herself as she had always been taught to do.

The preventive measures to be employed in any particular instance will differ somewhat according to one's conception of causes. In some

instances it may be impossible to prevent the onset of mental illness, but even in a case where some weakness seems to be inherited, prophylactic measures can be of service. Where the deficiency amounts to feeble-mindedness or some other equally grave motor or mental deficiency, institutional care may be necessary. A simplified and favoring environment, good food, exercise, and properly regulated rest will keep such poorly endowed persons within the realm of normality. Where the handicaps are not so crippling, compensation for defects is entirely possible. Alfred Adler's (*3*) success in dealing with personality problems of children lay in his skill in developing a "way of life" through which inherent deficiencies could be compensated for. Bagby (*21*, 180-183) describes the case of Snygo who was a physically frail but intelligent boy. He had developed a serious sense of inferiority because he was unable to compete with the other boys in sports. His school mates despised and abused him not only because of his incompetence in athletics but also because of his adult manner of speaking and his high achievement in his studies. Psychological study of his case led to a plan of action that resulted in satisfactory compensation and acceptance by his fellow students as an equal. He was given special private coaching as a football quarterback. His superior intelligence was a distinct asset, and long and arduous practice enabled him to handle the ball with great skill (*21*, 183).

Snygo's great day came when he was sent into a game in the last few minutes of play and succeeded in making the one play which brought victory to his school. It did not escape the notice of the student body that he had been called on in emergency and that the confidence put in him was rewarded Immediately his relation to his fellows became firmer, and gradually he was able to learn the types of conduct and speech which are esteemed by young boys.

There are occasions in the life of every child when unavoidable shocks occur, such as the experience of a thunderstorm when alone, a fall, or being bitten by a dog. By the process of conditioning, described in Chapter 4, a fright reaction thus engendered may become associated with some entirely innocuous situation such as a person, a place, or an article of food. Theories differ as to how important such accidents are in the development of later abnormalities. But it should be remembered that whereas conditioning can create such harmful associations, the process of reconditioning or deconditioning can remove them, as Jones (*332*) and others have demonstrated. It is important to discover the presence of the unfavorable association as early as possible, so that the growth of exaggerated patterns of response may be prevented.

The application of preventive measures cannot be limited exclusively to early childhood. People being as they are, through hereditary inadequacies or the defects of early training, maladjustments are bound to

occur. Something can be done even for the adult who is not prepared to meet his "obligations." In the case of an overcomplicated environment putting too much strain upon the human organism, the remedy is obvious, though difficult to provide in the case of any given individual, since the ill is primarily a social one. According to Patrick (*487*), environmental conditions should be simplified by the elimination of highly congested urban districts. In addition, opportunities should be available for rest and relaxation of a natural sort, as opposed to the highly artificial and emotionally stimulating recreations now so much in vogue. It was found possible to ward off the impending war neuroses in many cases without removing the person from his environment by the application of intelligent instruction and a careful regulation of the routine of life. A similar treatment will meet with success in civil life.

Speedy adoption of the simplified living conditions that are frequently recommended is out of the question for the majority of people. A return to outdoor life, with more walking, horseback riding, hunting, and fishing, the cultivation of the soil and the care of domestic animals, cannot easily be substituted for the automobile, the motion picture, the theater, dancing, and the reading of novels. It would require the reorganization of modern social life.

Any mental ills that can be attributed to educational methods ought to find ready correction. Changes in theory and practice occur frequently, and much of the present educational practice is patently experimental. That which is good will remain and the useless or the harmful will be disposed of. Of all the suggested causes of functional disorders the most stubborn will be found in the characteristics of our social institutions. If complications continue to multiply more rapidly than the human organism can adapt itself to them, the problems of prevention of disease will become more and more serious (*410*).

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Psychology in the Diagnosis of Disease

Psychological data and methods occupy an important place in the diagnosis of disease. In the organic and nervous diseases, many of the symptoms consist of sensory and other mental phenomena to be discovered by tapping the introspections of the patient, or by detecting them through psychological experiments. In the functional mental disorders especially, the changes in mental experiences constitute the disease itself and these must be discovered and evaluated by psychological methods.

NEED FOR A KNOWLEDGE OF NORMAL BEHAVIOR

In the use of mental reactions, either as indirect symptoms of disease or as direct evidence of it, a thorough understanding of normal human behavior is a primary requisite. The physician prepares himself for the diagnosis of physical disease by a study of normal anatomy and physiology, followed by a study of pathology. He studies the normal organic machine, how it works, and what it is like in order that he may learn how to deal with it when it gets out of order. Much less attention, or in many cases no attention at all, is paid to the need for a knowledge of psychological normality in all diagnoses. There are few diseases that do not depend for their correct diagnosis upon the introspective report of sensations and feelings by the patient. It is obvious that one cannot detect abnormalities of behavior unless he is thoroughly familiar with normal behavior.

The understanding of normal behavior is not such a simple matter as it would be if all normal mental reactions were alike. The fact is that normality covers a wide variety of performance. It is necessary, therefore, to know the nature and range of the individual differences that may be expected in any function, so that only the reactions that exceed this range shall be called abnormal. The interesting controversy concerning the skin sensations called "epicritic" and "protopathic" and

what happens to them in disease was in part a result of the differences of opinion as to what the sensations are really like under normal conditions (*53*). It is the business of psychology to establish norms of reaction, including the normal range of individual differences. Although a large body of such data is at hand, it should be made more available for the medical practitioner. Familiarity with this material should be required as a part of a medical training.

The study of normal association reactions first made on a large scale by Kent and Rosanoff (*340*) will serve as an illustration of the use of psychological norms in diagnosis. A list of one hundred words was arranged, and the free associations to these one hundred words, in the case of 1,000 normal people, were empirically determined. When the character of these associates was studied, it was found possible to detect normal tendencies in the case of each stimulus word, and also a normal range of variability. When the associations were classified according to quality, under such headings as rhyme, neologism, perseveration, and individual reactions, the association types of normal people could be made out. Unusual deviations from these norms were looked upon as suggestive of abnormality.

There should be included within the study of the normal behavior and the normal range of individual differences also the distortions, illusions, and suggestibilities that influence the validity of report but which are nevertheless a part of the constitution of normal people. The variations in the meaning of a "severe" pain for different persons, the error in the location of a pain, the illusions of perception, the errors of memory, and the influence of suggestion and expectation upon the character of the symptoms reported are only a few of the pitfalls of diagnosis (Chapter 5). Many of the typical pictures of the psychoneuroses are now known to be the product of the suggestible patient unintentionally guided by the examining physician. The simple knowledge of the possibility of such phenomena will pave the way for taking measures against them.

Wilful deception frequently complicates the problem of diagnosis and requires not only the ability to detect its presence, but also the ability to inspire confidence by manner, speech, and otherwise so that a maximum of cooperation between physician and patient may be obtained. Where these sources of error cannot be eliminated, the introspective report should be reinforced by more objective measures or the latter substituted for them wherever possible. There is a growing tendency to adopt such objective methods as blood analysis, the analyses of the contents of stomach and intestines, and the X-ray photograph, primarily because they make possible the diagnosis of pathological changes before they register themselves upon the consciousness of the

individual. However, there will always be numerous situations, especially in mental abnormalities, where such objective means cannot be employed.

Along with the knowledge of normal variations of behavior there should go a knowledge of the technique of psychological measurement in order that crude qualitative distinctions between what is normal and what is abnormal may give place to quantitative measures of difference. The need for quantitative methods follows naturally upon the recognition of the fact that normality covers a considerable range of performance, and that the difference between normal and abnormal is one of amount rather than of kind. The outstanding illustration of supposed qualitative differences is found in the case of intelligence, where the distinctions of idiot, imbecile, and the like have given way to a statement of degree of intelligence or of mental age in terms of points of score or years of age.

The principal theme of this book is the psychology of individual differences. Nearly every chapter is concerned with some specific difference or the means of measuring it, and a copious supply of references has been furnished. It should not be necessary at this point to do more than reiterate the importance for the student of medicine of all the preceding chapters.

The family doctor has one great advantage over the specialist of the present day in that he knows the "normal" idiosyncrasies of most of his prospective patients. He knows that this one invariably "runs a little temperature," and that one exaggerates his aches and pains, another one is inclined to be secretive about his ills, and still another has a low threshold of fatigue. When he is called at the onset of illness, he can take these characteristics into account as he builds up his clinical picture. The specialist who sees the patient for the first time when he is ill can measure him only against more general standards of reaction. Periodic examinations by one's doctor together with proper cumulative records will give further useful evidence of normal trends, and will bring to light the danger signals of changes beyond the range of the normal.

PSYCHOLOGICAL REACTIONS AS DIAGNOSTIC SIGNS

The psychological reactions that are accepted as symptoms of disease are so numerous and cover such a wide range of nervous and other diseases that it is feasible only to select a few samples from the various classes of mental experience (*693*). The sensory reactions furnish a multitude of symptoms in the nervous diseases. In hysteria, for instance, there may be a loss of the sensations of warmth or cold or both

FIGURE 113

A DIAGNOSTIC TEST FOR THE SENSE OF SMELL *

* From C. A. Elsberg and E. D. Brewer, "A Detailed Description of the Technique of the Two Olfactory Tests Used for the Localization of Supratentorial Tumors of the Brain," *Bull. Neurol. Instit.*, N. Y., 1935, *4*, 504.

in certain limited portions of the body, diminished sensitivity or complete loss of the pain sense, or exaggerated sense of pain; there may be anaesthesias of varying degree and extent. The sense of vision is frequently restricted to a narrow field, and sensitivity to colors may be likewise limited. Tabes dorsalis is characterized by a loss of the sense of movement and position of the limbs, accompanied by a local loss of pain sense and a weakening of the sense of touch. Motor symptoms such as paralyses, tremors, contractures, disturbances of the gait, and the aphasias are symptoms in such diseases as general paralysis, arteriosclerosis, cerebral hemorrhage, and diseases of the cerebellum.

The laboratory psychologist has elaborate and refined techniques for measuring the sensory and motor functions, generally based on one or other of the well-known psychophysical methods. These are seldom immediately appropriate for diagnostic purposes, since they take much time, require well-controlled conditions, and call for a degree of cooperation from the patient that he can scarcely be expected to give. The applied psychologist has not contributed as much in the way of useful applications in this aspect of diagnosis as he has in certain others, although he could undoubtedly render valuable service through the development of simpler testing procedures.

What the psychologist has not done the medical diagnostician has frequently had to do for himself. Thus the familiar Zwaardemaker olfactometer and the methods of using it were found inadequate by Elsberg (*159*) (*161*) for clinical use, whereupon he and his associates devised a more suitable apparatus and procedure. It is known as the "blast-injection technique" in contrast to the usual "sniff technique" in which the subject actively "breathes in" the odorous substance. While the patient sits at ease and holds his breath for a few moments there is injected into his nostrils at a given pressure a specified quantity of an odorous vapor. A threshold in terms of volume-pressure is said to be obtained in the course of a few trials which is sufficiently accurate to detect deviation from the normal sensitivity level and to discriminate between sensitivity levels of the two olfactory membranes (*158*). The procedure employed by Elsberg is pictured in Figure 113 (*160*, 504). A bottle of known volume is partly filled with the odorous liquid so that the air above it becomes saturated. By means of a syringe, a given volume of air can be driven into the bottle, developing a pressure that depends upon the level of the liquid in the bottle. When a clamp closing the tube that carries the nosepiece is released, the air rushes into the nostrils. The patient merely reports whether or not he smelled the odor. The blast-injection technique is now being thoroughly tested in the psychological laboratory as a possible improvement over the older methods for research purposes (*320*). If the tests

prove to be favorable, technology will once again have made a contribution to the science of psychology.

INTELLIGENCE AS A DIAGNOSTIC SIGN

A great variety of mental tests was applied by Tendler (*606*) to a group of fifty psychoneurotics (neurasthenia, psychasthenia, and hysteria) and their records were compared with those of normal persons. Table 82 shows the percentage of psychoneurotics that reached or exceeded the median score of the normals. The tests are arranged in the order of the degree of overlapping, with the case of greatest overlapping at the top. The order of reliability of the differences resembles closely the inverse of the order of overlapping. Greater differentiation was obtained by making a combination of the Hard Directions Test (speed) and the Memory for Forms, and giving each an appropriate weight. The overlapping of those reaching or exceeding the median of normals is then as follows:

TABLE 82

COMPARISON OF PSYCHONEUROTICS WITH NORMALS *

	Percentage of Psychoneurotics Reaching or Exceeding Median of Normals
Rote memory	56
Ink blot (imagination test)	52
Maze test (learning time)	52
Mixed relations	52
Maze learning (accuracy)	46
Trabue completion	46
Number finding (speed of perception)	44
Dotting test	42
Hard directions (accuracy)	38
Mixed relations (time)	34
Logical memory	32
Free association	32
Substitution	28
Knox cube	28
Cancellation	26
Memory for forms	24
Hard directions (time)	14

* Adapted from A. D. Tendler, "The Mental Status of Psychoneurotics," *Arch. Psychol.* (New York), 1923, *60*, 24.

	Per Cent		*Per Cent*
Psychoneurotics	12	Psychasthenics	11
Hysterics	17	Neurasthenics	8

According to this investigator, the tests discriminate between normal and psychoneurotic persons, although they do not discriminate among

the different forms of abnormality. The tests used in this experiment resemble the components of intelligence examinations so that it is possible to transmute the scores obtained into terms of mental age. When this is done, it is found that the average mental age of the psychoneurotics is 12 years and that of the normals is 14.3 years.

Hollingworth (*274*) has found intelligence differences among the various functional neuroses in a survey of 1,172 cases in army hospitals, as shown in Table 83 in terms of mental age. The median mental age

TABLE 83

THE INTELLIGENCE DIFFERENCES IN THE FUNCTIONAL NEUROSES *

	Number of Cases	*Median Mental Age*
Mental deficiency	40	8.6
Epilepsy	339	10.6
Hysteria	177	11.5
Constitutional psychopathy	48	11.5
Psychoneurosis	114	12.0
Concussion	41	12.3
Neurasthenia	83	13.0
Psychasthenia	10	14.0
Undiagnosed	232	11.6
Organic nervous disease	45	12.3
Psychosis	16	12 5
Cerebrospinal meningitis	26	14.0

* From H. L Hollingworth, *The Psychology of Functional Neuroses* (New York, D Appleton and Co, 1920), p. 88.

of the whole group is 11.7 years, with the normal at approximately 14 years. The only cases coming within the normal age are the psychasthenics and the cases afflicted with cerebrospinal meningitis. Hollingworth attaches considerable importance to intellectual status as conditioning the form that the pathological symptoms shall take, and believes that, although one cannot discriminate functional neurosis from normality on the basis of mental age, nevertheless differential diagnosis among the various forms may be facilitated by determination of mental age. Wells and Kelly (*696*) have made a similar study of the psychoses and find their development "without marked relation" to intelligence.

AN INDEX OF DETERIORATION

One of the serious difficulties encountered in the use of mental tests for diagnostic purposes resides in the fact that normal performance records for any given individual are usually lacking. One cannot know beforehand the persons for whom norms of performance are going to

be required. The range of individual differences that can be expected within the mental functions is sufficiently great to make almost any test record fall within the conceivably "normal" for some persons. Until a standardized battery of mental tests comes to be universally applied in the public schools or at some other convenient life period this difficulty will remain. Babcock (*19*) (*19a*) (*20*) has attempted to meet the difficulty by employing an indicator of intellectual status which is little subject to deterioration. For this purpose she has chosen the vocabulary test, and for two reasons. The first is that vocabulary is the best single indicator of intelligence, since "some kinds of words cannot be learned by persons of inferior intelligence as measured by the criterion of ability in school and college work." The second is that vocabulary resists deterioration from any cause, partly because words are learned early in life and "old learning lasts practically unimpaired, except possibly for slowness of response, while ability to fixate new impressions shows weakness in varying degrees according to the degree of deterioration."

Babcock has derived an index of deterioration which expresses the relationship between a vocabulary-test record and the records on a battery of thirty tests calling for speed and the learning of new reactions. Thus of two patients having almost exactly the same battery score (9.36 and 9.33), the one was discharged from the hospital as recovered and the other was held as unimproved. The former had a vocabulary score of 8, whereas the latter had a vocabulary score of 17, showing that the former was a little better than his "normal" and the latter was seriously deteriorated. Although the index suggested by Babcock has met with criticism from time to time (*85*), and although it may not entirely live up to first expectations, it is serving as a clinical test of deterioration and will continue to do so until a more refined measure becomes available.

ASSOCIATION TESTS

The difficulty in the measurement of deterioration has been met in the case of word-association tests by establishing norms of reaction, and by assuming that a certain degree of departure from these norms will indicate abnormal functioning of the association processes. The Kent-Rosanoff Free Association Test (*340*) (*530*) was standardized on 1,000 normal people. For each of the one hundred words in the test there is a table showing the distribution of the responses of the 1,000 persons. The value of the test depends upon the assumption that the idea that comes to mind and is expressed, when a given stimulus word is presented, will come from the past experience of the individual, and

further, that the idea which has been associated with the stimulus word most frequently will be the one that will come to mind most readily under normal circumstances. Thus, for normal persons whose environment and experience have been such as life in America affords, the most likely responses to a set of simple words can be predicted. When a person, who follows instructions to respond with the first idea that occurs to him, gives queer and unusual reactions, that in itself may be taken as a matter which needs interpretation, for it indicates that the responses are probably not controlled according to the well-known psychological laws, and that some other influence is at work. Further examination may reveal a "satisfactory" reason for the divergences, but if not they may be taken as symptoms of mental disturbance.

Kent and Rosanoff (*340*) concluded from a comparison of the responses of 247 patients with 1,000 normal cases:

> With the aid of the frequency tables and the appendix, normal reactions, with a very few exceptions, can be sharply distinguished from pathological ones. The separation.. simplifies the task of analysis and makes possible the application of a classification based on objective criteria.... In *dementia praecox,* some paranoiac conditions, manic-depressive insanity, general paresis, and epileptic dementia the test reveals some characteristic, though not pathognomic, associational tendencies.

The hopes originally expressed that the association reaction test would furnish a highly sensitive instrument of differential diagnosis among the various mental diseases has not been entirely sustained by subsequent applications of it in its simplest forms. For example, the results obtained by Murphy (*447*), who compared the reactions of 250 normal persons, 120 dementia praecox cases, and 82 manic-depressive cases, were disappointing in that they showed no significant group differences. The detailed analysis of particular associations, the statistical analysis of association times, and the use of more complex stimulus words and the survey of a wider range of diseases might prove to be valuable.

MEASURING DISTURBANCES OF THE HIGHER MENTAL FUNCTIONS

Theoretical considerations and practical contacts with patients suffering from various forms of abnormality have led Goldstein (*222*) to divide the total personality into two capacity levels, the higher level, which is the abstract, and the lower level, which is the concrete. Each level "furnishes the basis for all performances pertaining to a specific plane of activity. In other words, each attitude constitutes one definite behavioral range, which involves a number of performances and re-

sponses." Within each level there are various degrees or grades of performance, but a sharp distinction occurs between the two levels. A normal person combines both levels of behavior and can shift from one to the other as need arises. Some situations can be met only with the abstract type of responses, some with a combination, whereas others require only the concrete reaction. Deterioration manifests itself in a weakening or loss of the abstract form of behavior (*222*, 2-4).

> [The concrete level] does not imply conscious activity in the sense of reasoning, awareness or a self-account of one's doing. We surrender to experiences of an unreflective character: we are confined to the immediate apprehension of the given thing or situation in its particular uniqueness—our thinking and acting are directed by the immediate claims which one particular aspect of the object or of the outerworld situation makes .. The abstract level embraces more than merely the real stimulus in its scope It implies conscious activity in the sense of reasoning, awareness and self-account of one's doing We transcend the immediately given situation, the specific aspect or sense impression: we abstract common from particular properties. we are oriented in our action by a rather conceptual viewpoint, by a category, a class or a general meaning under which the particular object before us falls

Goldstein and Scheerer cite the case of a patient who was asked to pick up a comb from a table and take it to the examiner. She could not do it without stopping to comb her hair. The concrete situation forced the habitual response. Another patient could use a key to open a door but could not demonstrate how to use the key in the absence of a door. Still another patient could drink out of a full glass, but when given an empty one to demonstrate how he "would drink" he was unable to do so. In the monograph cited above the authors present five tests for the measurement of deterioration of abstract behavior, with detailed descriptions for their administration.

Bolles (*51*), working on the Goldstein conception of abstract and concrete behavior levels, administered a series of sorting tests to groups of aments, dements, and normal children. Although she was primarily concerned with the qualitative analysis of the reactions of individuals, she found evidence of differences among the groups and to that extent confirmed the findings of Goldstein. Nadel (*460*) tried out similar tests on patients who were suffering from lesions affecting primarily the frontal lobes. He found that his tests discriminated between a group suffering from a disturbance of the frontal lobes and a group in which the lesions had occurred elsewhere. The distinguishing characteristic appeared in the loss by the former group of the abstract form of reaction as defined by Goldstein, with no such loss in the latter group. If these results are adequately confirmed by other studies, the weakening or loss of abstract behavior will point toward a diagnosis of lesions of the frontal lobes.

TESTS OF IMAGINATION

The group of tests included under this heading is intended, according to Wells (*691*), to find out how one looks at his environment and what he sees there. The implication is that where one is faced with an objective situation that is susceptible to a variety of interpretations, he will read into that situation his own personality, his interest trends, his thoughts, his images, and perhaps also his anxieties and his fears. In this sense the free-association test and some of the controlled-association tests could be included here, for those tests carry the same implication. What difference there is, lies in the degree of freedom given the subject to express his personality (*694*). The further implication in the use of the tests of imagination for diagnostic purposes is that disturbances of the personality will display themselves in a deviation from the expected norms.

Two classes of tests are to be distinguished, though they differ in degree rather than in kind. The first uses the ink-blot type of material which has a minimum of conventionalized meaning and of which the Rorschach test is the most important illustration; and the second is the picture-interpretation type which carries some meaning, but which nevertheless permits varied elaboration. The best current example of such a test is the Thematic Apperception Test of Murray (*452*) which has been used mainly in the analysis of normal persons.

The Rorschach test, or more correctly the Rorschach technique, is an excellent illustration of a clinical method since it yields no single total score, nor do the part scores lend themselves to statistical treatment. On the contrary, a case calls for an overall survey, in which the interpretation of any one part is dependent upon the interpretation of other parts. The test is being very widely used for diagnostic purposes, but the great difficulty involved in ascertaining its reliability and validity in the customary manner impels the statistically-minded psychologist to maintain an open mind concerning its significance. However, those who use it in practice have deep confidence in it as an interpretative instrument. Beck (*31*) has tested healthy adults of superior intelligence, the feeble-minded, the depressed, the hypomanic, the schizophrenic, the neurotic, adults with conduct disorders, and problem children, and derives typical personality pictures of them. It is not feasible to reproduce here any samples of personality deviations in terms of Rorschach symbols.

Murray employs a number of imagination tests, in addition to the Thematic Apperception Test, including an Imaginal Productivity Test, using ink blots; a Musical Reverie Test, which calls for the interpretation of fantasies aroused by listening to phonograph records; and a

Dramatic Production Test, which calls for the creation of a dramatic scene from an assortment of toys. All are of the same general nature in that they invite interpretation of an objective situation in the light of one's personality. Murray's extensive trial of the tests was carried out on normal college men so that he does not offer clinical pictures of the various classical abnormalities. But his results with these tests have led him and his collaborators to the conclusion that it is possible by their use to reveal "emotionally logical connections between past events and present behavior."

EMOTIONAL STABILITY TESTS

The so-called tests of emotional stability are aimed at essentially the same goal as those just discussed, but they differ sharply in that they are tests; that is, they are standardized and lend themselves to the more conventional type of scoring and statistical treatment. In their present form they are modifications and elaborations of the Woodworth Personal Data Sheet, devised by Woodworth during the first World War and published for the first time by Franz (*179*). It became necessary during the war to weed out from the drafted men those who would be susceptible to emotional breakdowns from the strain of the war conditions. Woodworth devised his test to perform this service. The original material consisted of a set of 200 personal questions covering symptoms usually reported in case histories of the mental diseases, and prepared so as to be answered by underlining "Yes" or "No." A few sample questions and their answers are given below, where "wrong" answers, sometimes "Yes" and sometimes "No," are italicized.

Do you usually sleep well?	Yes	*No*
Are you bothered by fluttering of the heart?	*Yes*	No
Are you bothered much by blushing?	*Yes*	No
Is your head apt to ache on one side?	*Yes*	No
Do people find fault with you more than you deserve?	*Yes*	No
Did other children let you play with them?	Yes	*No*

The questions were answered by large numbers of university students and drafted men in the army. Those that were answered "wrong" by the normal group were eliminated as useless questions. When the series of questions that remained was given to a group of individuals known to be abnormal and including dementia praecox, neurasthenia, epilepsy, hysteria, and psychopathic personality, the average number of "wrong" answers was thirty-six. It was tentatively assumed that an individual giving twenty or more "wrong" answers should be suspected of instability, and one giving thirty or more should be suspected of actual abnormality. Elaboration and further stand-

ardization of the test have been carried out by many persons so that there are today numerous forms and varieties of the test available. It seems to have proven itself serviceable both for detecting abnormalities in their incipient stages and for differential diagnosis. Among the best known varieties of the test are the Thurstone Neurotic Inventory (*644*), the Bernreuter Personality Inventory (*38*), the Humm-Wadsworth Temperament Scale (*302*), and the Laird Personality Inventory (*355*).

The second World War has made most insistent the demand for a satisfactory test that will be predictive of personal stability. Psychologists are at work upon such an instrument and although no evidence can be published at present, there is reason to believe that there will come forth an instrument as good for its purpose as the Army Alpha examination was for the measurement of intelligence.

THE SEARCH FOR MENTAL CAUSES OF DISEASE

The psychological devices thus far discussed are offered as aids in the diagnosis of maladjustments and diseases of many sorts. There remains to be considered the possibility of discovery by psychological means of mental reactions that themselves constitute the disability.

In the adjustment of the human organism to its complicated and varying environment, the mental aspects of behavior occupy a very conspicuous position. Likewise, the maladjustments that appear in the effort to survive are predominantly mental maladjustments. It is natural, therefore, to look for the sources of inadequate adjustments in the mental experiences. The essential point to note is that the individual must react in some fashion—complete inactivity is not compatible with the continuation of life—hence maladjustments rather than absence of adjustment. The particular form that the individual adopts to meet the obligations of life gives the character to his disease.

It is not necessary for our purpose to enter into the discussion of the question whether there can be functional disorders independent of organic derangement, although this question has been and still is the subject of controversy (*408*). It will be sufficient to remark that psychological concepts are most applicable to the so-called functional mental and nervous disorders, without attempting to catalogue them.

THE CONFLICT OF MOTIVES

The process of adjustment presupposes an organism equipped with certain tendencies to action, or motives, and a complex environment in response to which the motives lead to action (Chapter 2). The conflicts

result from the interplay of the motives themselves and from the obstacles to their satisfaction that are interposed by the social and other forces of the environment. The individual is rare, indeed, who can completely harmonize these conflicting forces; the one who fails entirely to do so is liable to some form of functional disorder. The more usual person is he who is doomed to a degree of frustration, such as that described by Dollard (*142*) and his associates and said to result from interference with a "goal response." Since the human organism cannot long remain inert, it strikes out and becomes aggressive. Thus it tends to meet frustration with aggression. However, the aggressive behavior itself may come into conflict with social prohibitions and, as a consequence, engender further frustration or become suppressed. Whatever has been suppressed will continue to seek expression either in its original form or in some modified form. For instance, the gnawing pains of hunger may be suppressed for a time by concentrating the attention upon the benefits to be derived from fasting, but the desire for food will force itself upon the attention until the appetite is satisfied. A process of rationalization frequently occurs whereby the individual justifies to himself the forbidden course of action. Many examples of such behavior will be found among drug users. The following history is typical. A young doctor sought to offset the effects of the strain of overwork by resorting to the use of a drug, feeling that he could readily resist the formation of a habit. After the habit had become fairly well established, he took carefully adjusted doses of atropine so as to counteract the contraction of the pupils of his eyes (the effect of the drug), and thereupon argued to himself that he was resisting the effects of the drug. When his family and friends became suspicious of him and began to watch his movements he reasoned that he would show them that he was more cunning than they. He thus further justified his use of the drug and invented all sorts of ingenious means of concealing it and of using it.

The more primitive impulses commonly undergo repression through the force of customs, laws of morality, codes of ethics, and religion. If the ideals supported by one or more of these systems are sufficiently strong, the "baser" impulses may be crowded out of consciousness effectually during waking hours. In such a case they may express themselves in the form of some substitute reaction as in the case of a childless woman who "pampers" her lap dog, or the "smoker who renouncing the practice, chews gum." Or they may express themselves in dreams or waking phantasies. When the impulse is a powerful one and the need for repression is imperative, the form of expression that it will take is oftentimes such a gross distortion of the original mode of behavior that it is unrecognizable to the individual himself. The curious

symptoms of the neurotic such as those described in non-technical language by Hart (*243*) are explained by the Freudians as a manifestation in disguised form of such suppressed impulses.

PSYCHOANALYSIS

The system and the techniques (*214*) of the psychoanalysts are built up by the elaboration and modification of these relatively simple concepts. The conflicting tendencies conceived as mental phenomena are said to remain such even when suppressed, and are called a complex. Since they are not in consciousness, an *unconscious* (or *subconscious*) realm is conceived wherein they may reside. As they remain active while repressed, some agent must be responsible for keeping these impulses out of consciousness. This is the *censor,* which stands guard over the passageway between the conscious and the unconscious. Explanation is required for the fact that the suppressed tendencies do at times manifest themselves in consciousness and in overt behavior in one form or another. This is found in the theory that the censor is less acute during sleep so that the suppressed ideas elude its vigilance and appear in dreams. The censor may be eluded also when the suppressed content appears in a symbolic form and is, therefore, not recognized in its true nature. Symbolism is said to be necessary during sleep in some cases so that certain especially tabooed inhabitants of the unconscious may escape in dreams.

All tendencies to action do not play an equally important part in this chain of events. Usually one or other of them is given a dominant position. For Freud (*187*) and many of his disciples, the sex drive is the one primarily responsible for all motivation normal and pathological. His unconscious is populated with such suppressed desires. They become active while the individual is still in the period of infancy and may even then, by slight accidents, become exaggerated and distorted and pave the way for trouble in the life of the adult. Jung (*333*) has adopted a much broader conception of motivation and the nature of the unconscious than Freud. He replaces the sex urge by the energy principle of life, the two most significant manifestations of which are the sex impulse and the nutritive impulse. Adler (*3*) relegates the sex urge to a subordinate position and sets up in its place the self-assertive tendencies. Stekel (*581*) adopts a still broader notion and, in addition to the sex urge, he emphasizes the importance of motivations emanating from religious feelings, the instinct of self-preservation, and ambition. A further concept, belonging especially to the Freudian system, makes way for drawing off or diverting the energy of the suppressed tendencies into other and more socially acceptable channels. This "sub-

limated" energy accounts for the inspiration and urge toward art, science, business, industry, in fact all useful work.

THE DIAGNOSIS OF FUNCTIONAL DISORDERS

The theories of the functional disorders vary with the conception of the fundamental drives. Freud finds the root of all neuroses in the sex instinct, which has been suppressed and which finds expression in the bizarre reactions of the neurotic. The symptoms are disguised fulfilments of the sexual impulses. Jung finds the cause of the neuroses in the blocking of the form of expression that the vital energy normally takes in adaptation to the demands of life. This energy accumulates and, being denied an appropriate outlet, escapes through more primitive modes of expression, which are the abnormal or neurotic manifestations. Adler believes that "all forms of neuroses and developmental failure are expressions of inferiority and disappointment," and derive from the thwarting of the self-assertive tendencies.

The diagnosis of the particular disease, according to the psychoanalytic system, consists in bringing to light the suppressed content and explaining the symptoms to the patient in psychoanalytic terms. Since these very data have been suppressed and manifest themselves in consciousness only in symbolic form, some indirect means must be employed for their exposure. Chief among these is the analysis of the patient's dreams, where less disguise is necessary for the escape of the desires. The chief instrument in such interpretation is a set of fixed symbols for the elucidation of the dream content. Day dreams, phantasies, slips of the tongue and pen, lapses of memory, phobias, and obsessions are likewise analyzed by means of symbolism.

Another means of discovering hidden content responsible for neurotic symptoms is known as the "free-association" method. It consists in requiring the patient to start with some element of one of his dreams, a slip of speech, or the like, and to let his mind wander freely from this starting point, reporting all ideas that occur to him, without any reserve or self-criticism whatever. The patient himself recognizes when a complex is reached by the sexual content of the ideas. Jung's association-reaction method differs from this in the fact that he presents a list of words and the patient is required to call out a reply to each word. Those words that provoke an abnormal reply, either in the character of the response or in its delay, are said to be connected somehow with the suppressed complex.

Still another means of exploring the region of the unconscious for its suppressed content and especially for those forgotten experiences of childhood and infancy that are supposed to be of so much significance,

is the method of hypnotism. It is said to be useful also in the recovery of forgotten dreams, that make such excellent material for analysis and interpretation. It is not clear just why hypnosis should reveal complexes unless it acts as an exaggerated form of sleep and thereby reduces the repressive power of the censor, or unless, by the added concentration of the attention which the patient is able to exert under the influence of the hypnotist, memories may be the more readily revived.

The Freudian concepts here outlined, as well as the method of diagnosis based upon them, have been subjected to severe criticism from the point of view of scientific psychology The concepts of the dominance of the sex motive, of the unconscious, of the censor, of sublimation, of symbolism, have failed to attain a secure position in systematic psychology. Concerning the psychoanalytic theory, Woodworth (*717*) says:

> The pragmatic argument will not work in this case. We have a number of other treatments, all more or less successful in treating neurotic cases, and each one purporting to be based on a different theory If the psychoanalytic treatment could be rigidly deduced from the Freudian theory and from no other known theory, or even if the practice had originated as a deduction from the theory, this argument would have weight As a matter of history, however, the treatment grew up first, and the theory was then developed as a sort of rationalization of the treatment. The theory is extended far beyond the needs of the practitioner. The psychology of the Freudians, and also their views on history, mythology and the world in general, are not essential to the practice, but are to be regarded as products of the decorative art.

Landis (*356a*) examined the accounts made by ten psychologists (*603*) of their experiences while undergoing psychoanalysis and derived from these reports certain psychological phenomena common to all of them. They were, conditions of anxiety and resistance, the revival of forgotten memories, regression, the redintegration of forgotten emotional experience, dream symbolism, transfer, and insight. Each of these Landis translated into the language of the laboratory psychologist. When stripped of the metapsychology of the psychoanalyst and thus translated, he finds little that is not scientifically acceptable.

OTHER DIAGNOSTIC METHODS

Emphasis has been given to the psychoanalytic method, not only because of its prominence at present as a diagnostic instrument, but because of its influence upon the public mind, upon literature, upon religion, upon the interpretation of social phenomena and of the great events and characters of history. Other diagnostic methods are meeting with success which are based upon the conception of conflicts

among motives native and acquired, and which may be discovered by study of the personal history of the patient and by conferences with him after his cooperation has been secured. There is a growing tendency among practitioners to recognize in neurotic cases an hereditary predisposition, with the result that the particular symptoms that the disease may manifest, rather than the disease itself, are looked upon as the product of the conflicts that have been described. Among such predispositions are the character types introvert and extrovert, suggested by Jung, the organic inferiority, suggested by Adler, the low psychic tension and low reserve of energy, suggested by Janet, and the vaguer concepts of the Freudians (*62*, 251-268).

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Psychology in the Treatment of Disease

The conception of the functional diseases as maladjustments of the organism to the conditions of life implies in all methods of treatment a readjustment process—a readjustment of the individual in respect to his habits of living and his attitudes toward his problems and in respect to his emotional responses. It implies also, in many instances, a readjustment of the environment in a variety of respects, where it is necessary to meet native and unchangeable shortcomings of the individual. This essential readjustment may be accomplished in a number of ways, although one method may be more effective or more expeditious than another with a certain type of patient.

Amid the confusion and controversy among rival techniques throughout the history of the psychological methods in medicine, the one fact is clear that satisfactory readjustment of the patient has been accomplished by the most diverse and conflicting procedures. Cures by rest are matched against cures by excitation and by work; cures by fasting are matched against cures by forced feeding; cures by magic are matched against cures by religious symbols; cures by exhortation are matched against cures by silence (*317*) (*732*). The search for the common element in all these treatments reveals the attempt to produce change from an inadequate, primitive, or abnormal system of responses to a sane and healthy one.

The fundamental psychological principles of education, or rather of reëducation, must be obeyed in this process of reconstruction. The use of such words as suggestion, hypnotism, synthesis, clarification of complexes, and catharsis, does not always imply a thorough understanding of the mental processes involved, nor does it necessarily follow that the terms stand for any authentic mental processes. The term reëducation has not been used in a strict psychological sense, but has stood for practical processes, with little attempt at psychological analysis, description, or formulation. It has carried somewhat the meaning "to lend a helping hand," "set a good example," "give direction and

advice," "provide an incentive," "give encouragement," or "arrange for new surroundings." All these phrases, it is true, emphasize the mental functions of a psychological organism rather than its physiological processes. This emphasis is perhaps responsible for the first two syllables of the word psychotherapy. And it follows, of course, that acquaintance with the laws of mental and motor behavior, and with the elements, attributes, and patterns of mental processes is favorable to satisfactory work on this plane, as it is also in teaching children, hunting wild beasts, and selling goods. The use of such vague psychological concepts has not implied any very profound knowledge of the refinements of modern psychology but rather a sympathetic acquaintance and toleration for human nature. That is why successful therapeutic work has frequently been accomplished by ministers, school teachers, and laymen.

PSYCHOLOGICAL AIDS IN THE TREATMENT OF DISEASE

Before examining the strictly psychological methods of treating ailments, there is another form of service that deserves notice. Just as in the course of diagnosis it is necessary to make use of mental symptoms such as pains, anaesthesias, worries, and hallucinations, so in the course of treatment, changes in these symptoms will indicate the course of the disease. Standardized psychological techniques for measuring sensitivities, motor reactions, levels of intellectual capacity, and degree of emotional stability can be called into service to detect improvement or deterioration.

Woodworth (*714*), many years ago, called attention to the value of quantitative measurement as a supplement to clinical observation:

> ... the maniacal condition appears to be one of accelerated mental and motor activity; but tests have shown that this appearance of speed is deceptive, and that the maniac should be called slow rather than fast in his thoughts and movements. Similar tests have shown that the condition of alcoholic intoxication which seems to make a man preternaturally prompt and fertile in the production of ideas is at bottom a condition in which the process of association is slower than normal, and in which the stock of ideas is impoverished rather than enriched. To take another sort of case, idiots appear to constitute a class by themselves, a subspecies of the race, but tests seem to prove that they are after all not separable by any sharp line from normal individuals, that there is no typical idiot standing at the center of a "distribution curve of idiots" but that they are simply those members of the race who differ in the most extreme degree from the normal type. There are probably numerous other instances, some of theoretical and some of practical importance, in which the current descriptions of abnormalities would be changed by the application of experimental methods.

The examination of hookworm patients by Strong (*593*) in the course of their treatment will serve as an example of what psychological measurement can accomplish. By a series of tests he measured the mental alertness of children who were about to be placed under treatment. He examined in the same way a control group of healthy children living under the same general conditions, and also a group of hookworm-infected children who were not submitted to treatment. After the treatment the various groups were reëxamined by the psychological tests and determinations made of such changes in mental condition as may be produced in the normal and untreated groups by mere repetition and growth, and in the treated groups by these factors plus medical treatment for the disease.

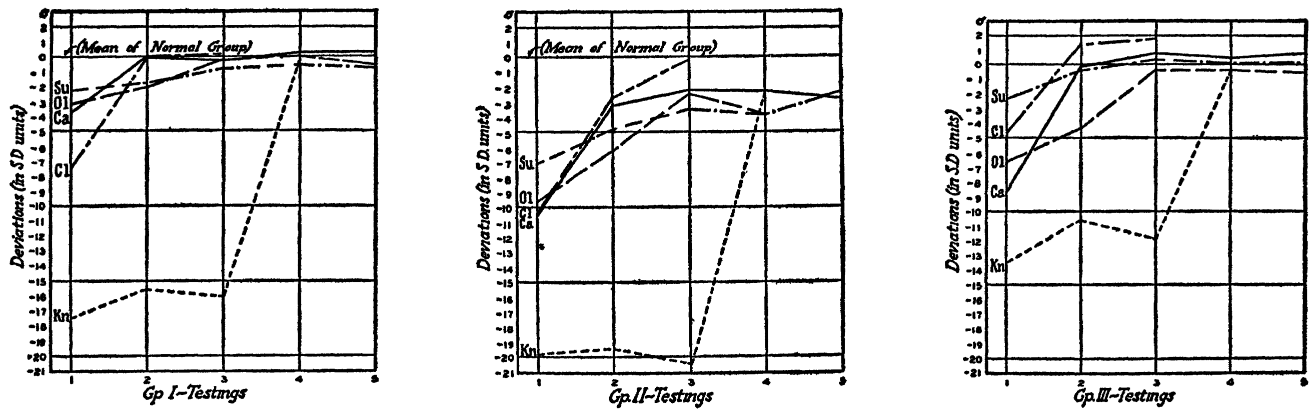
The results of this investigation enabled the investigator to conclude that hookworm disease unmistakably affects mental development, that treatment alleviates this condition to some extent but it does not, immediately at least, permit the child to develop as he would if he had not had the disease, and that prolonged infection may produce prolonged effects upon mentality—effects from which the individual may never entirely recover.

The great increase in the number of standardized tests for general and special functions since the hookworm study by Strong has opened a wide vista of possible psychological service. Conkey's (*111*) measurement of psychological processes in head-injury cases is a step toward the cultivation of this new opportunity. She employed a battery of tests to determine what psychological functions were involved and the extent of their involvement, and repeated the tests at intervals in order to detect changes during the treatment and to mark the time at which the patient could be considered cured. She used three groups of tests, those involving simple mental functions, those requiring more complex and symbolic activity and depending mainly on old knowledge and association, and those that require new learning on an abstract level.

Three groups of cases were followed, namely, the head-injury cases which were the particular object of the study, a group of cases hospitalized for non-traumatic reasons, and a control group of matched normal individuals. The second group was necessary in order to allow for the effects of hospitalization regardless of its cause, and the third group provided the customary controls to pick up the effects of repetition of the tests. The tests were repeated at varying intervals over a period of about one year. It is not possible to present the results in any detail, but the three sets of curves reproduced in Figure 114 will show that the changes from one repetition of a test to another were quantitatively measurable, and that the change varied according to the level of the test. Five head-injury cases are recorded on each chart, as

FIGURE 114

PSYCHOLOGICAL CHANGES DURING TREATMENT FOR HEAD INJURIES *



* Adapted from R C Conkey, "Psychological Changes Associated with Head Injuries," *Arch Psychol* (New York), 1938, No 232, 40-41.

well as the mean of the normal group. The vertical scale is in terms of S.D. units of deviation from the mean of the normal group. The base-line scale gives the test periods from one to five, the actual time interval between periods varying from case to case. The first group of curves represent the tests of simple functions, the second the tests of symbolic functions using learned material, and the third the tests of the new acquisition of abstract material. The author's conclusions suggest that it is entirely feasible to measure psychological changes not only in head-injury cases but in any other form of disability. Babcock's tests (*19*) described on page 575 as devices for diagnosis have also demonstrated their utility in following the progress of treatment in a variety of diseases. These examples are offered merely as indications of the potential utility of a great range of psychological tests as adjuncts in the treatment of disease.

PSYCHOLOGICAL THERAPY

It should be the purpose of the author at this point to describe the peculiarly psychological methods of treating disease. As he has shown elsewhere (*503*), however, this is extremely difficult to do as it calls for such a definition of terms as will sharply distinguish the therapy of the psychologist from that of the psychiatrist and of the social worker. The first term that needs definition is *therapy*.

Webster's *New International Dictionary* cites therapy as a substitute word for therapeutics and defines therapeutics as follows: "That part of medical science which treats of the discovery and application of remedies for diseases." Even the Warren *Dictionary of Psychology* defines therapy in almost exactly the same terms, namely: "The branch of medical science which deals with the treatment or application of remedies to the cure, alleviation, or prevention of disease." Disease is in both these definitions the crucial word. How is that word defined? The Warren *Dictionary of Psychology* says "disease is an abnormal condition of mind or body involving a derangement of one or more functions." If these definitions are to be accepted, then therapy of body or mind is a part of medical science. With these definitions in mind is there anything particularly absurd in the bill offered to a state legislature "making any treatment... of any mental condition" a part of the practice of medicine and providing for the punishment of unlicensed practitioners? As some one remarked not too facetiously, "Universities exist for the treatment of ignorance and since ignorance must certainly be a mental condition, university instruction comes to be a purely medical function." If one consults the dictionary again, he finds that psychological means "having to do with mental phe-

nomena." Therefore, defined in the very broadest sense, psychological therapy is the therapy having to do with mental phenomena. A sharply contrasting definition would be that *psychological therapy is that therapy which can be or is practised by a psychologist.* Thus defined, and bearing in mind the definition of therapy, there can be no *psychological therapy.*

Certain difficulties arise out of these definitions. The first difficulty arises from the fact that psychologists are not so readily identified as one might suppose. Thus Murray (*451*), in his observations on training for therapy, says:

> One is forced to acknowledge that university men have not contributed the ideas which have thrilled the imagination, nor have they provided the kind of answers that satisfy one's curiosity or meet one's needs. No. These have come from the *medical* psychologist—Janet, Prince, Jung, Rank, Adler.

Still more confusing perhaps is the fact that among the membership of the American Psychological Association there are fifty persons who hold both an advanced degree in psychology and the degree of Doctor of Medicine. Some of these are medical men who later took graduate training in psychology, and others are psychologists who followed training in that field with the study of medicine. Are the therapies devised and employed by such persons to be classed as psychological therapies or medical therapies?

OVERLAPPING OF PSYCHIATRY AND PSYCHOLOGY

A quotation from Dr. William Healy's book (*254*, 10), *Personality in Formation and Action,* will show that the foregoing is not a purely academic and artificial statement of the case against any strictly psychological therapy, but represents a current point of view in psychiatry:

> Let us remind ourselves that by derivation and recent usage the word psychiatry is not confined in its significance to the science and art of dealing merely with definable mental disease. Open to psychiatric investigation and treatment there are many faulty mental functionings which are only revealed in minor personality deviations or maladjustments, or in undesirable behavior. True, psychiatry with its first interest in mental abnormality has learned much from gross psychopathology; yet, like medicine, it has advanced from centering on pathology to interest in normal functioning, from concern with therapy for mental disorders to concern about the correction of personality ineptitudes and the maintenance of wholesome characterial tendencies. And these last goals have, naturally, great import for human interrelationships as well as for the individual We may readily agree with the writer who begins his article on psychiatry by stating: "The ultimate aim of this branch of medicine should be to ascertain the best means to promote normal thought and action, individually and collectively."

There is expressed in this statement by Healy the unmistakable recent trend in psychiatry from the treatment of mental abnormality toward the correction of minor faults of behavior and personality lying clearly within the realm of normality. To an observer who is neither psychiatrist nor clinical psychologist this appears to be the most striking aspect of the modern trend in therapy.

On the other hand, the psychologist who has contributed so largely to the educational techniques for dealing with the normal child through his study of the learning process has, at first gradually but with increasing acceleration, expanded his interest and activity to include deviates from the normal, both in purely intellectual functions and in personality traits. Such an expansion seems natural and inevitable. With the introduction of the techniques for measuring both intellectual level and educational achievement there followed the classification of children and their segregation into groups according to their educational needs. Special educational techniques were devised to correct deficiencies disclosed by the testing program and to make the most of the potentialities of those who were by nature poorly endowed. Thus, in addition to classes for the feeble-minded, there have been developed special classes and remedial techniques for children who suffer disabilities in reading, who have defects in speech, are hard of hearing, have poor vision, and those who experience difficulty with any one or more of the usual school subjects.

More pertinent still was the discovery that children handicapped in these ways and, in fact, children who deviate in any respect and to a marked degree from the general run of their associates, are likely to suffer certain personality difficulties—difficulties of social adjustment. Thus the very bright child placed in a group of older, bigger, and more stupid ones may need special attention and guidance to steer him safely through difficult times. The personality problem of the stutterer or the poor reader may be even more serious and calls for sympathetic understanding and friendly counsel. But this is reëducation, adjustment, and a step in the direction of therapy, if not actual therapy itself.

Still more striking has been the discovery that frustration and confusion, arising from inability to solve problems and meet complicated life situations, may lead to complete disorganization of behavior with the customary symptoms of mental breakdown. The technique of the conditioned reaction in the hands of Pavlov working with dogs, Liddell (*10*) (*377*) working with sheep, and Maier (*391*) working with rats, has made possible the experimental creation of psychoneuroses by conditioning, and their cure by reconditioning, retraining, and other treatments (*11*). No small part of the significance of these studies lies in their implications for the treatment of human maladjustment. Thus

the concept of conditioning, which is in its essence a very old and familiar concept to the psychologist, has seemed to many who have studied the evidence to offer a therapy which the psychologist is competent to administer.

A CLASSIFICATION OF THERAPIES

Grace Arthur (*16*) has reported a series of cases treated by "tutoring therapy." Tutoring a child to correct educational maladjustments brought improvement also in social adjustment and removed the serious conditions for which the child was originally brought to the clinic. In each of these cases there were detected serious family involvements which had not been dissipated and which, for various reasons, the psychiatrist had not treated. Tutoring seemed to be the effective therapy in these cases, although the family complications remained untouched.

There are apparent two general trends in therapy; one, stemming from the distinctly abnormal, carrying the psychiatrist into the realm of the normal, and the other taking off from the normal and leading the psychologist into the abnormal. Today these fields overlap, and the boundary lines have become blurred. The following list of the common therapeutic techniques has been arranged roughly in an order such that those in which the psychologist can contribute most and with which he is most adequately prepared to work come first, and those which clearly call for a medical or psychiatric training come last. The exact order is not important.

1. Tutoring therapy
2. Play or recreational therapy
3. Training or habit therapy, positive and negative
4. Attitude therapy
5. Insight therapy
6. Occupational therapy
7. Consultation therapy
8. Relaxation therapy
9. Suggestion therapy
10. Affect therapy
11. Dream and association therapy
12. Psychoanalytic therapy
13. Physiotherapy
14. Medical therapy
15. Surgical therapy

The surgical therapy, medical therapy, and physiotherapy surely call for a medical background. As for the next, psychoanalysis, the case is not so clear, since the so-called "lay analysis" is generally practised

outside of the United States and was strongly advocated by Freud himself. Beginning at the other end of the list, one can move about half way before he meets techniques for which a medical or psychiatric training will provide preparation and for which psychological training does not prepare more or less adequately. There are certainly three at the beginning of the list that are clearly psychological techniques as the three at the end are medical techniques.

In any discussion of such a list of therapies two factors are recognized by all persons concerned as of prime importance. These are the *need to establish proper rapport,* and the *need to discover and deal with organic involvements.* A great deal of needless mystery is thrown around the former, so that the establishing of rapport has seemed to become a kind of ceremony. It means merely the creation of a harmonious relationship, a high degree of confidence, and calls for sympathetic interest and understanding of one person by another. There is nothing particularly obvious in the training of either the psychiatrist or the psychologist to make him an expert in getting rapport. In fact, so far as children are concerned, the social worker, the school teacher, and even the understanding mother, should have an advantage. Lowrey (*386*), in reporting his experiences at the Institute for Child Guidance, has said concerning the training of psychiatrists:

> Our psychiatrists have said they have a great deal of difficulty in making their first approach to children. We find very frequently that is because they are afraid of children. They have had little or no professional contact with children Some have had no recent personal contacts. Some were unmarried; some were married but had no children; none had large or well-grown families.

In fact, there is evidence that in the public schools at least, the psychiatrist may be peculiarly handicapped in establishing proper relations with cases, so that the children may prefer to go to a psychologist rather than to the "nut" doctor. Many adults appeal to the psychologist for help for much the same reason.

With the detection of organic involvements, the case is entirely different. No one of the therapies should be employed by any one without a competent check-up of physical condition. Even a mild disability in reading may have as its basic cause some obscure organic condition which calls for correction before retraining can be safely employed. Only stupidity or gross negligence can account for failure to advise adequate medical examination.

In the light of the foregoing discussion, it will be obvious that the applied psychologist in the field of therapy will need to steer his course with caution. He can make definite contributions, the most important of which will be a knowledge of normality. He should be able to iden-

tify a normal adult personality and to describe the various stages of development leading up to it. Such information is essential for the detection and treatment of the deviations from the normal. As the topics normality and the normal range of individual differences have been discussed elsewhere and particularly in the preceding chapter, nothing further will be said of them. Psychology should have useful data to contribute to a number of the therapies that have been listed and some of them will be briefly referred to.

TREATMENT BY SUGGESTION

Among the earlier methods of treatment, such as the use of magic, religious exercises, animal magnetism, as well as among the more recent developments of Christian Science and New Thought, suggestion seems to play an unwitting but important rôle (Chapter 5). The elements of mystery, wonder, and power surrounding the curative agent are well calculated to put the patient in the state of expectation appropriate for effective suggestion. There are no particular theories underlying the methods included in this group, unless it be the complete denial of the reality of the symptoms such as occurs in some of the modern cults. The readjustments that are wrought are comparable with the experiences of religious conversion or with the breaking of a strong habit and the establishment of a new one in its place in the case of normal individuals. In fact the mechanisms of the treatment accord to a degree with James' (*314,* Vol. I, 123) well-known law of habit formation, to "launch ourselves with as strong and decided an initiative as possible." When a sudden and revolutionary readjustment of habits and attitudes has been thus accomplished, a permanent cure may possibly ensue. But an effective treatment should follow James' instructions further:

> Accumulate all the possible circumstances which shall reinforce the right motives, put yourself assiduously in conditions that encourage the new way; make engagements incompatible with the old... This will give your new beginning such a momentum that the temptation to break down will not occur as soon as it otherwise might, and every day during which a breakdown is postponed adds to the chances of its not occurring at all.

In other words, a real readjustment, whatever the method by which it is initiated, in order to conform to sound psychological principles, should include such a regulation of the environment, and such a program of activities that the discarded reactions cannot recur. The method of suggestion, if it satisfies these requirements, may meet with success.

Hypnotism was employed by Prince (*511*) and a form of partial

hypnotism or relaxation by Sidis (*565*) for facilitating the readjustment process. It was reputed to be possible by these means, when skilfully used, to gain a maximum of coöperation from the patient, and, by eliminating resistance and positive antagonism, to increase the speed with which new habits and attitudes can be established.

PERSUASION

Closely related to the foregoing methods are those that employ persuasion, sermonizing, exhortation, and moralization upon the patient. The doctor will explain the patient's condition to him and exhort him to adopt a more rational attitude toward life. This treatment will be repeated day after day and for hours at a time until the patient finally succumbs, and accepts the proposed modes of reaction or is pronounced an incurable case. There is in this method a large component of suggestion either intentional or unintentional. It is more successful, naturally, where the physician inspires confidence and carries the authority engendered by a long list of cures to his credit. Psychologically, exhortation is not, when taken alone, a sound method of reëducation, and unless supplemented by the laborious process of establishing proper ideals and purposes and correct habits and attitudes, should be expected to be of very limited value. The whole trend of modern education is away from such methods and toward the use of properly controlled exercise in the right course of action.

RELAXATION AND REST

Several methods of treatment seem particularly directed toward building up the energy supply of the patient, although they have been known as psychological methods. The rest cure associated with the name of Weir Mitchell has had a long history. Rest is sometimes supplemented by complete isolation and the prohibition of conversation. Where the personal history of the case shows evidence of exhaustion, such treatment is advocated by Janet (*316,* 149-206) and others as a preliminary to psychological treatment. It would seem logical enough, in the treatment of mental as well as physical ailments, that the body should be well nourished and as free from fatigue as possible. The rest and isolation have been used frequently as the curative process rather than as a preliminary to it. It has been suggested that the treatment is a kind of punishment, which is more unpleasant than the condition that the patient escapes by the adoption of his symptoms. Hence, he is led to readjust his behavior in order to escape the punishment. This treatment is usually accompanied by persuasion on the part of the physi-

cian with the suggestive influence that this implies. As stated above, such devices may serve as secondary aids in directing the course of the readjustment.

Economy of energy is an especially vital factor in the treatment of the neuroses according to Janet. For him the neurotic is an individual who is constitutionally deficient in energy or, at least, is one whose stock of energy is readily depleted as the result of emotional shock, fatigue, or strain of any sort.

> Most disorders of behavior result from a lack of these forces. If I may be permitted such a comparison, all these diseases are nothing more than various ways of going bankrupt and falling into misery.... Nothing is more urgent when one is confronted by an individual on his way to bankruptcy than to reduce his expenses and to establish a strict economy. (*316,* 206)

The treatment consists, not in confining the patient to complete rest in bed, but rather in a simplification of his living conditions. His complicated situations must be resolved, his responsibilities must be reduced, his decisions must be made for him, prolonged effort must be avoided, and the need for adaptation to changed conditions must be reduced to a minimum. A modern version of the therapy of relaxation will be found in the writings of Jacobson (*311*) who by experimental research has attempted to put the evidence for the curative power of rest and relaxation upon a strictly scientific foundation. He has found that complete relaxation can be learned at any age including the very young and the very old and by the mentally deficient as well as by the normal. In the conditions where it is not the primary therapy employed, it will serve as an aid to whatever treatment is being applied.

PSYCHOANALYTIC TREATMENT

The psychoanalytic treatment, as distinguished from diagnosis, consists in redirecting the energy of the sex impulse (or other impulses according to the theory) which finds outlet in an abnormal attachment to some object or person, and the expression of which constitutes the symptoms of the neurosis (*214*). This readjustment is known as sublimation. The procedure consists, first, in the transference of the attachment to the analyst, from whom it is then redirected or sublimated into various useful channels. The impulse remains the same, although the means of attaining its satisfaction are found in a great variety of dignified reactions. McDougall (*408,* 473) describes the process of sublimation as follows:

> If a puppy is taught to obtain food by sitting up and "begging" for it, instead of straightway seizing it in his teeth, that might be called intellectual sublimation of the simplest kind; and if, in the service of the same impulse, he learns

to perform a complicated trick in order to obtain his food, that is a further stage of the same process. In the same way, if a child, instead of being allowed to obtain what he wants (food, or any other natural goal) by merely seizing it or clamoring for it, is taught to earn it, as the reward of a useful or kindly action, he is being led to sublimate his instinctive energies. In the animals only a very limited kind of intellectual sublimation is possible; but man is capable of vastly greater intellectual sublimation; and, what is more important, he is capable of moral sublimation; that is to say, man can learn to substitute for his natural goals, goals higher in the moral scale; the same instinctive impulses that would have impelled him towards the natural or instinctive goal, then sustain his efforts toward the higher goal.

According to the Freudian view, the sex impulse, diversified thus by the process of sublimation, is the driving force toward all life's intellectual, ethical, and aesthetic activities. Sublimation, thus interpreted, is almost, if not entirely, coextensive with education, although education is not assumed to derive its impelling force solely from the sex impulse. The exact technique by which the sublimation is accomplished differs somewhat according to the particular point of view of the psychoanalyst, but for all it consists in the delicate process of guiding and inspiring the patient into a normal course of behavior. It comes about as the culmination of long and repeated conferences between physician and patient, during which the closest confidence is established between them through the act of transference. The personality of the physician thus plays a very significant part in the treatment. The guidance is aided and facilitated not a little by the use of suggestion, a device that at one time was repudiated as foreign to the psychoanalytic method, but has recently been acknowledged as a distinct aid. Barring the particular terminology and the emphasis upon the sex tendencies, the sublimation process is closely akin to those already discussed, and is essentially a process of reëducation.

REEDUCATION

All the methods of readjustment thus far mentioned are in a sense forms of reëducation, although the psychological principles underlying educational methods are subordinated to some special theory or are entirely neglected. The reëducation method advocated and employed primarily by Franz, Wells, and others in America represents an approach to the problem from the psychological point of view. The patient is viewed from normality as a starting point, and all his reactions are treated as deviations from the normal. This difference in approach may appear to be of little consequence, yet it frequently has a pronounced influence upon the methods of treatment, as appears from an instance cited by Franz (*180*). A patient was suffering from an apparent in-

ability to speak and write as a result of a gun-shot wound in the neck, which was supposed in some way, such as the severance of nerves, to have caused the disability. He was brought, for special examination, by his physician who reported the circumstances of the case and the efforts that had been made toward reëducation.

The patient proved to be psychoneurotic and his disabilities were in danger of being fixated by the attitude of the physician that there *must* be something wrong. At the same time this attitude counteracted the beneficial effect of the expectation that the patient was normal and could perform the tasks required. According to Franz (*180*, 209-210):

> The principle of reëducation is that of habit formation. It is either a replacement of old, inadequate or harmful methods of reacting with new habits more like those of the other individuals in his environment, or it is the formation of new habits to take the place of those that have been lost. In other words, reëducation is to the abnormal what education is to the normal—it is a matter of acquisition of habits that will enable the individual to take his place in the working, playing, social world.

The successful reëducation of patients with functional disorders requires that the patient must have some insight into his abnormality, at least to the extent of recognizing that he is different from other people; that he must have or acquire the desire to get well; and that he must have confidence in his physician or instructor. Finally, he must have careful guidance and supervision in the course of the reëducation process. All the devices that have been found to be effective in facilitating learning and giving it a permanent fixation should be employed. The proper distribution and duration of trials, the demonstration of improvement by measuring and recording performance, and the use of incentives to effort appropriate for the particular case may be borrowed directly from the psychological laboratory. The generous use of suggestion and encouragement are recognized as valuable assets. These principles of education or of reëducation are being applied with remarkable results by Carlson (*86*) and others in the treatment of motor disturbances and paralyses of many varieties.

PSYCHOLOGY AND THE MEDICAL SCHOOL

The importance of psychological data and methods as adjuncts to the more customary diagnostic and treatment methods, and directly in the diagnosis and treatment of mental disorders, as well as their importance in the understanding of the personality of the patient, raises the question of the place psychology should occupy in the medical school. When the curriculum of the typical medical school is analyzed, it is found that the experience and training of the student are largely

clinical. This means that his observation is, for the most part, of pathological conditions. He may easily fail to acquire sufficient information concerning normal types, and the direction, conditions, and range of normal variability. Such knowledge, which might well be partially furnished by adequate psychological training, would at least warn him of the fallacies of generalizing clinical findings without due regard for the facts of normal variability.

The medical course as it is now offered seems to provide little training in exact and purposive experimentation. An excessive proportion of the student's time seems to be occupied with the memorizing of anatomical minutiae, most of which are straightway forgotten, the disciplinary value of which is at least questionable, and the content of which is always accessible in the manuals. It seems for these reasons that one of the most fruitful contributions which psychology can make to medicine is a rigorous, specially adapted, full-year course in experimental psychology, which should be incorporated at an early point in the curriculum of the medical schools. In such a course much stress should be laid on methods and techniques of arriving at experimental certainty, avoiding logical fallacies and inductive errors, and of adequately controlling the grounds of inference under circumstances in which very slight factors may play important rôles.

THE CLINICAL PSYCHOLOGIST

In recent years there has been a slowly developing tendency to introduce special knowledge and skill of a psychological sort into hospital service, in connection with examination and case work, nursing, therapy, and research. During and since the first World War this movement was given an impetus through the recognition that the reconstruction of patients in the military hospitals was in many instances essentially a reëducation process. Not only in neuropsychiatric hospitals but also in institutions for the care and treatment of orthopedic and surgical cases, for the blind, deaf, and tubercular, and especially in connection with occupational therapy, points of contact were found between psychology and medicine.

Occupational activity has not only its aspects of diversion and exercise, but may be specifically directed toward the restoration of particular members, functions, and muscle groups. After an inventory of the patient's aptitudes and interests, his intelligence and educational preparation, such work may be more intelligently and effectively directed toward the patient's ultimate advantage as well as toward his present functional requirements. The well-established principles of educational psychology are entirely relevant to the processes of reëducation as well,

and reëducation is coming more and more to be recognized as an important phase of therapy. Educational psychology and its applications may afford assistance not only in the technique of reconstruction, but also in the preliminary inventory of capacity and disability.

Furthermore, many patients will require vocational readjustment after discharge, and experience shows that a competent vocational psychologist may also be of service in this process of readaptation to economic and social life. During the hospital residence and after discharge or parole, moreover, the general factor of morale has high importance. Whether the development and maintenance of morale be undertaken by physician, nurse, social worker, or psychologist, it is definitely a psychological undertaking.

In particular instances, notably in conditions such as aphasia, functional nervous complaints, various paralyses, and in recovery after operations and amputations, intensive individual reëducation has great usefulness. There is reason to believe that a certain proportion of individuals who now deteriorate under institutional treatment might profit materially through discerning individual reëducation. This seems even to be the case in those psychiatric pictures commonly diagnosed as dementia praecox, in which the prognosis is usually considered unfavorable.

The value of psychological measurements and records of the changes in capacity under given remedial measures has already been indicated. By such means not only may useful records be secured for correlation with the therapeutic measures, but the patient's attitude toward his own condition and toward the therapy may be usefully improved by picturing to him concretely the actual increments of functional restoration from day to day.

Finally, the hospital psychologist may undertake various research projects, following up clinical, experimental, and statistical suggestions, especially in cases where the patient's conduct and general adjustment to life are of special concern. In the case of neuropsychiatric conditions, these suggestions are especially relevant, and it is in such conditions that the application of the psychologist's skill and knowledge is regarded most hopefully.

This brief survey of the services of a psychological character that are now called for, or soon will be called for, in the treatment of patients, shows that neither the psychologist nor the psychiatrist nor the general practitioner is equipped to render them. The lack of an adequate training program has been vigorously pointed out by Murray (*451*). Poffenberger (*503*, 760) has proposed:

> ... the creation of a coördinated program of training for the profession of mental therapist. Such a program will mean scrapping old traditions of therapy

as the treatment of disease, breaking with old traditions of the medical school training of the psychiatrist and of the purely academic training of the clinical psychologist. Whether the new product, after extracting what is essential from psychiatry, psychology, social work, and elsewhere, will resemble more nearly the psychiatrist, the psychologist, or the psychiatric social worker of today, should be a matter of small moment. That a professional group shall evolve which is in every respect competent to deal with the menace of the growing army of the mentally unfit is a matter of utmost concern to all.

Harrington (*242*) has gone still farther and has proposed the establishment of a "School of Mental Health" whose principal function, as described on page 558, would be to provide a more adequate form of mental therapy than the practising physician is able to obtain for his patients at the present time.

Whether the need that has been outlined above can best be met by modifying the training of the doctor of medicine, or by modifying the training of the psychologist, or by creating a new profession cannot be safely predicted at present. There can be no doubt that the need will be met.

35

Psychology in Education

It is appropriate that the presentation of the principles of applied psychology should close with a chapter on the applications to education, for nowhere are these principles so universally applicable. The two sets of foundation facts upon which applied psychology rests are individual differences and the need for adjustment to these differences. They are equally basic facts for education. Education represents the first practical activity in which the applications of psychology were made in any systematic way. So numerous and so varied have these applications become that a working knowledge of psychology is now generally required of all teachers. In training schools for teachers the courses in general, experimental, genetic, abnormal, and differential psychology constitute an important part of the curriculum.

Between the two fields of psychology and education the coöperation has been so long established and so cordial that the content of general psychology has been much enriched through investigations whose primary problems were educational. Furthermore, practically all the matters dealt with in the preceding chapters have a direct bearing upon the problems of education and many of them represent portions of the content of educational psychology. Since these things are true, this chapter on the relation of psychology to education will indicate only the main directions of application and give suggestive illustrations of those that have not been discussed.

THE EDUCATIONAL PROCESS

The early conceptions of education treated it as a single, unitary process of "training the mind," "molding character," and "giving culture." A real step, however inadequate one may now consider it, was taken when the "mind" was analyzed into distinguishable and namable "faculties," and the effectiveness of teaching was regarded from the point of view of those faculties. Still more wholesome and influential

was the further step in analysis in which these faculties (such as memory, instinct, imitation, perception, attention, and will) were realized to be but convenient and artificial names given to various groups of specific habits and tendencies. "Learning" or "culture" was thereupon broken down into more elementary and constituent aspects, school subjects were separated one from the other, and attempts were made to correlate them in the curriculum in such a manner that each set of tendencies or habits would be given adequate attention, exercise, or inhibition.

Further application of this analytic process led to the discovery that a school subject, such as arithmetic, is by no means a unitary enterprise on the part of teacher or student, but in itself involves a considerable variety of more elementary processes, each of which must be considered in detail if the whole is to be adequately and economically mastered. In arithmetic the ideas of amount, of units of sequence and position, of counting, of grouping, and of manipulating; familiarity with the symbols; comprehension of the operations and meanings which the symbols denote, must all be recognized. Questions at once arise concerning the most "psychological" sequence and organization of these various functions and processes.

Not only is the school subject thus reduced to its constituent processes, but each operation in one of these processes is ultimately analyzed into a group of still more specific acts and habits. Thus in such a simple operation as adding a column of numbers

> ... investigation seems to give evidence that ... eight or nine distinct functions are involved, each of which calls for the use of several bonds. Besides these positive connections, a child in learning (to add) must inhibit other connections which are incorrect, and these must often outnumber the correct ones. And yet column addition has always (heretofore) been treated as a simple habit—with perhaps one element of complexity when carrying is involved. It is evident that if the habit concerned does involve eight or nine different functions, a child might go astray in any one His difficulty in forming the habit might be in connection with one or several of the processes involved. Knowledge on the part of the teacher of these different steps of the habit, and appreciation by him of the possibilities of making errors, are the prerequistes of efficient teaching of habits. (*587*)

In a similar way such a concept as that of the child's "will" has been clarified only by analyzing it into the constituent motivational and emotional trends. These motivational trends in turn are understood only by recognizing them as native and acquired needs and desires which demand satisfaction (Chapter 2). The emotions are comprehended only by breaking them up into the elementary feelings and their combinations, and by investigating the physiological processes underlying them.

It should not disturb the student of applied psychology or of education to discover that this process of analyzing behavior into smaller and smaller specific units may have gone too far and that a reaction in the contrary direction is discernible. A radical return swing of the pendulum away from the so-called molecular concepts has occurred in biology (*105*) and in physiology (*221*) and is now being reflected in psychology, particularly in the concepts of Gestalt psychology. It is reflected also in the so-called "total personality" point of view represented by Allport in his *Personality* (*6*) in contrast to what has been called the "atomistic" conception. The infiltration of this concept of totalitarianism into education is observable in the *Principles of Educational Psychology* by Commins (*109*) which is organized upon the organismic concept. As usual, the applied psychologist in education as in other fields will find his best working formulas within the "middle of the road" rather than at either extreme. Generally this intermediate position evolves out of an overlapping of the extremes. Thus, the sharply contrasting concepts of learning known as "trial and error" and "insight" have merged into an interpretation that might be called "growing insight" or "insightful trial and error" (Chapter 4).

THE RAW MATERIALS OF EDUCATION

Long before psychology became recognized as an independent field of scientific inquiry, writers on educational subjects were mainly occupied with discussions concerning the nature of the child's mind, the sources of his interest, the varieties of his powers, and the modifiability of his capacities. The work of education came to be conceived as that of effecting changes in the behavior or feelings of the individual who was taught.

The "original nature of man," his inborn tendencies to attend, react, and retain, his predispositions, the range and limits of his capacities, the rate at which these mature, the conditions of their effective activity, their transitoriness, their mutual inhibitions and reënforcements, must be learned by the teacher either beforehand or through painful experience (Chapters 2 and 3). For these original traits are given only in the form of certain large and vague tendencies, and the task of education consists in so working with them as to make the individual effective in the circumstances and for the purposes for which he is to live. Some of these tendencies must be inhibited if he is to be socially adapted, as, for example, his tendencies to take what he sees, to strike when injured or affronted. Other tendencies must be selectively trained, stimulated, and specialized, as his tendencies to vocal utterance, to motor activity, and to construction. In such processes it is important

to know in some detail the ways in which original tendencies may be modified, the consequences of their enforced suppression, and their futility unless directed. Punishment, disuse, and substitution may all be employed in this process, but by no means all of them with equal success or on all occasions.

THE INDIVIDUAL AS THE UNIT OF MODERN EDUCATION

Whatever confusion certain psychological theories of mental organization may have created in the educational process, psychology has made an unquestioned contribution in that it has forced attention upon the individual and impelled educators to adapt methods of instruction to suit him. This shift of attention from the earlier theories of education to the concrete facts about individuals brought about a revolution in educational methods as radical as those that later occurred and are still occurring in business and industry. In all these fields the new concept has gained such impetus that no obstacles, whether institutional, administrative, or financial, can long withstand its advance. The changes in education have been so great and so widespread as to leave practically no single person unacquainted with them.

The knowledge of the ways in which individuals differ from each other, of the degrees and directions of this variation, of its causes and educational consequences is the foundation on which must be based all discipline, all differentiation of studies, all guidance and advice. Some idea was given in Chapter 1 of the nature and magnitude of these differences. Especially characteristic of modern education is the study of individual differences in mental constitution, and the attempt to recognize these differences in classification, discipline, and teaching. The traditional classification on the basis of chronological age has given way to the recognition of mental levels. The discrepancies between intellect and achievement that are commonly encountered in unimproved public schools are well illustrated in a case cited by Terman (*608*, Chap. 5). Two classes from the fifth grade of a school system were studied intensively, and yielded the data shown in Table 84.

Two students in class *A* are capable of doing eighth-grade work, one-fourth of them are ready for the seventh grade, and one-half for the sixth grade. On the other hand, there are in class *A* eight pupils who are adapted for only fourth-grade work. In class *B* there are fourteen pupils capable of only fourth-grade work, seven who should be in the third grade, and one who probably belongs in second grade. These differences among students in the same class, making uniform instruction impossible, are paralleled by the differences found between the

classes that are supposed to attain the same standards of achievement. The median IQ of class *A* is 108, and that of class *B* is 91. Class *A* has 44 per cent of cases with an IQ of above 110, whereas class *B* has only 10 per cent; class *A* has 19 per cent of the IQ's below 90, whereas class *B* has 44 per cent. The achievement of the two classes, measured by standardized educational tests, shows equally striking differences. In addition, subtraction, multiplication, division, and in reasoning, the average difference is more than two school grades, although differences in spelling are considerably less.

TABLE 84

Individual Differences among Fifth-Grade Students *

	Class A	*Class B*
Number of students	41	38
Range of chronological age	9 5 to 14 years	9 5 to 15 years
Range of mental age	10 to 15 years	7.8 to 14 years
Range of IQ	78 to 148	60 to 144

* From L. M. Terman, *The Intelligence of School Children* (Boston, Houghton Mifflin Co., 1919), p 71.

Every teacher of experience can recall from earlier years of work, case after case in which labor, worry, and sacrifice were entailed by the failure to recognize, in the "problem," a mentally defective boy, an adolescent girl, a neurotic parent, a paranoid superintendent, or a senile member of the board. Many a microcephalic child, with his irremediable mental limitations, has caused the teacher sleepless nights, and many a pupil has in turn been seriously impeded through life because of the principal's failure to understand the true nature of a speech defect, a choreic tic, or a proclivity for day-dreaming.

There is no excuse today for such maladjustments of students, for general school success can be predicted with a high degree of accuracy. Some notion of the scope and value of such prediction of attainable educational level was given in Chapter 15 by way of the forecasts of Terman for elementary-school children, of Cobb for high-school children, and of Thorndike for college students.

It should be mentioned incidentally that the concept of individuality in modern education applies to teacher as well as to student. It is no longer considered adequate to characterize a teacher as good, fair, or poor. The teaching function has been broken down into such elements as instruction, discipline, leadership, and social and moral influence. Indeed, each of these is recognized to be a very complex process. The task of teaching a class from the point of view of instruction alone is analyzable into the steps or stages of preparation, presentation, com-

parison, and abstraction, generalization, application, and drill or review. Faulty instruction is detected and remedied in terms of still smaller specific elements. A multitude of devices have been published by means of which teachers can be rated for their various qualities. These take one or other of the many forms described in Chapter 14.

DEVELOPMENT OF THE INDIVIDUAL THROUGH EDUCATION

Reaction tendencies in the form of feeling, conduct, or knowledge, not provided by original nature, must be impressed on the individual in the form of habits. Talking, reading, writing, using a machine, the multiplication table, and a thousand habits, simple and complex, must all be individually acquired. It is the task of education to see that these habits are most adequately, economically, and permanently acquired. Here, then, all the laws of learning, all the studies of memory, all the facts and principles of habit formation, interference, forgetting, and association are of vital importance in the operations of the classroom, the laboratory, and the textbook.

The advantages of spontaneous effort over mechanical repetition, the relative effectiveness of reward and punishment, the influence of motive and incentive, the inadequacy of imitation, the importance of pleasure in success, the expectation of a systematic curve of learning, the meaning of plateaus, the value of determining tendencies, intentions, and purposes, the value of a problem or project, the character of play tendencies and their possibility of useful organization and direction, the specific nature of habits, the absence of any considerable transfer from one field to another, the significance of identical elements in materials, work habits, or general attitudes, all these are but random selections from an endless list of principles that have been evolved from psychological investigations in the laboratory and in the classroom. Many of them have been discussed in the preceding chapters.

A familiar experiment of the psychological laboratory consists in the observation and recording of the processes of acquiring some new habit or act or skill. An animal may be placed in a cage from which it can escape only by performing some simple or complex set of movements, after which it may be rewarded by food. Or a human being is given some new task to learn, such as solving a puzzle, acquiring dexterity in some muscular feat, or becoming proficient in the use of some instrument, some set of symbols, some type of judgment. Records of the modes of attack, variations in method. types of errors, rate of learning, conditions of improvement, degree and ease of retention, tendency to distraction and interference, effects of disturbance, introspections of

the worker, and similar facts, enable the experimenter not only to picture in a graphic way the course of the act of learning, but also to formulate various general principles concerning the relative effectiveness of different methods and the differences between individuals. These have been demonstrated in earlier chapters particularly as they have found application in the industrial or work situation.

The work of the teacher consists mainly in supervising the formation of habits of these and related types. It is therefore useful for the teacher to become familiar, through performing such experiments in the laboratory or observing them in a demonstration, with the tendencies and principles underlying the learning process. In a similar way the classical experiments in memory, perception, and attention all have their technical and professional value in picturing in concrete and systematic form the psychology of the pupil. It would be difficult to find a classical psychological experiment that does not, at some point or other, admit of practical application in education.

If now, for the more or less artificial materials and acts of the laboratory, the mastering of actual school subjects and operations be substituted, the laboratory technique leads to a genuine experiment in education, especially if the experiment be performed on such individuals as comprise the school population. In this way the value of various methods of instruction, arrangements of material, amounts of drill, distributions of practice, proportions of study, rest and recitation, lengths of class period, and so forth, may be accurately and quantitatively determined. In such cases the laboratory technique is employed not merely by way of illustration but as an instrument of educational research.

By such experimental methods, for example, one pioneer investigator (*516*) was able to measure the arithmetical abilities of pupils in several grades in a number of schools. He found that the results of teaching varied greatly from school to school, the capacity in each school appearing consistently in all of its grades. By comparing these data with the amount of time given to arithmetic in the school programs, the size of the classes, the age of the pupils, and the conditions of their home life, it was shown that none of these factors was responsible for the differences in arithmetical ability. It is hence suggested that variations in methods of teaching and supervision are perhaps the responsible factors. The influence of these factors may be measured in the same experimental way.

In the modern school not only are efforts made to adjust the curriculum and the extra-curricular activities to the individual differences of the pupils, but special classes and methods are adapted to the particular needs of the feeble-minded, the backward, the precocious, the sick,

the crippled, the blind, and the deaf (*255*) (*286*). Even special classes for those to whom spelling (*177*) (*285*), or arithmetic (*631*), or reading (*200*) present special difficulties are by no means uncommon. The poor speller, the truant, the blockhead, the prodigy (*284*), instead of being sources of worry, prayer, and administrative despair, have become the subject-matter of zealous scientific research.

THE MEASUREMENT OF EDUCATIONAL PRODUCTS

The derivation of scales for the measurement of intellectual level was originally prompted by the urgent need for such measures in school supervision and administration. In the comparative experiments of pedagogy it is desirable, if possible, to select the pupils to be tested in such a way that groups of equal native capacity be submitted to the conditions of the experiment. In the consideration of an individual pupil and his educational difficulties it is first of all important to know whether he brings a normal intelligence to bear on these difficulties or whether he is originally inferior or superior in mental equipment. His disposition and treatment, his classification and direction must be random unless these facts are ascertainable. Scales of mental measurement make possible the prediction, long beforehand, of the probable quality of the pupil's later academic and vocational achievement, thus in many instances saving waste to society, accident to industry, expense and worry to parents, and fruitless effort to teachers and supervisors. The individualization of pedagogy is made more completely possible by the construction and elaboration of the various types of scales for mental measurement and intellectual diagnosis. Through the intelligent use of these products of the laboratory, the selective work which previously required years to accomplish may often be effected in a single hour.

Growing out of the development of scales for the measurement of general mental level, and closely related to this movement in method and purpose, is the work on the derivation of scales for the measurement of special school products (*462*). By methods originally devised for the measurement of experiences and materials whose values could be serially arranged but not quantitatively expressed, the qualities of such products as handwriting (*624*), literary composition (*602*, 84-112), drawing, spelling (*495*), arithmetic (*462*), reading (*200*), language ability (*602*, 148-161), and mechanical construction can now be evaluated.

By the use of such scales the pupil himself can observe in a definite way the progress of his learning. The teacher is enabled to check up her methods of instruction and drill, since such scales make possible direct comparison of one class with another. The practical impossi-

bility of making such comparisons without the use of standardized measuring scales has been demonstrated many times.

The educational supervisor may from time to time determine in exact ways the relative effectiveness of the instruction of different teachers, in so far as the value of this instruction depends on the character of the children's work. Standards of performance may be laid down for the various school grades and uniformity of practice developed in different parts of the school system. Statements of individual capacity in school subjects may assume quantitative form, and the assignment of grades and marks may lose much of its variability and unreliability. The work of one school system may be compared with another, and the utility of surveys thus extended beyond the consideration of buildings and grounds, ventilation and salaries, so as to include the actual psychological products of the classroom. No student of applied psychology can afford to ignore these important field instruments, how they are made and used, and the nature of the results obtained from their use.

EDUCATION OF THE PERSONALITY

The study and treatment of maladjusted personalities and the theories of the causes of maladjustment that have grown out of them have attracted attention to the early years of life as the critical period for personality development. Proof that the mechanism of the conditioned response functions at birth or earlier has likewise strengthened the belief in the importance of the early years of life for normal development. Consequently, the responsibility for the proper cultivation of the child's personality and for the correction of maladjustments that have occurred in the pre-school years has come to rest heavily upon the elementary school. The discussions of crime and disease in the preceding chapters have demonstrated forcibly the need for normal personality growth.

The progressive schools have attempted to meet their responsibility by putting almost as much emphasis upon the personality as upon the intellect in their program of work and play. Whether one speaks of a mental-hygiene program or merely of modern education, according to Ryan (*538*, v):

> ...In many schools of today one finds an atmosphere of friendliness and happy activity. Much of the traditional formality, the forced silence, the tension, the marching is gone. Children's voices are heard in the halls and classrooms. The younger children come gaily down the stairways, naturally and relatively unrestrained, the older boys and girls throng the corridors or outside walks, making their way to school rooms, shops, studios, libraries, laboratories, and playing fields—to tasks that mean something to them, that make demands

upon their energies and their imagination, that often involve hard, difficult work, but work that they recognize as creative. Beauty of surroundings is considered a first requirement in these schools—there are flowers about, brightly colored murals painted by the children, attractive, informal workrooms for the various groups . . . Art and music have begun to play the rôle that belongs to them as fundamentals in education and life.

There should be added to this picture the child-guidance clinics, the school psychiatric service, the vocational service, and the visiting-teacher service that bridge the gap between school and home. The whole pattern of the educational program may seem unduly elaborate and costly, but it will be fully justified if it prevents only a fraction of the crime and disease that are said to come from early maladjustment. The correctness of the philosophy and the practical consequences of the plan can be measured only in the statistics of a coming generation.

Both Morgan (*438*) and Sherman (*561*) emphasize the point that mental disorders, whether they be mild or serious, come in part from the inability of the individual to solve his own problems. The child overprotected in his home is likely to meet with obstacles in school that seem to him impossible to surmount. Therein lies one of the greatest potential liabilities of the school environment and at the same time one of its greatest potential assets. The liability becomes transformed into an asset when the obstacles are intelligently graded in difficulty by the teacher so that their magnitude grows as the strength and capacity to meet them grows. The child does not, then, acquire the habit of sidestepping his responsibilities by feigning illness or playing "hookey," which may be early steps toward criminality or neurosis, but instead he meets his tasks with the confidence that he can accomplish them. This process of adjusting the task to the competence of the student to meet it is not an easy one for the teacher. It requires an intelligent insight, a knowledge of human nature and a sympathetic interest that relatively few teachers possess. When an incompetent teacher tries to make the adjustment, the outcome is likely to be a coddling of the child, whereby the road to achievement is made too easy. Herein lies the justification for the severe indictment of modern education so frequently made, that it does not prepare the child for the realities of life. Maladjustments due to overprotection can be just as serious as those which arise from expecting more of the individual than he can deliver.

The solution of the problem of educational adjustment will come most readily, not from discarding the modern point of view in education, as critics so often advise, but, as Ryan (*538*) clearly points out, from the selection and training of more competent teachers.

ADULT EDUCATION

If it ever was true that one had completed his education at any specified age, it is certainly not true today. Education has been broadly defined as a process of adjustment, and acceptance of that definition means that the process of education for any individual never ends as long as he has life. Environment, and especially social environment, is constantly changing and the rate of change seems to be accelerating. Learning acquired in the "horse and buggy" days became outmoded with the advent of the automobile, and the learning of the latter period is becoming even more rapidly outmoded with the rapid expansion of aviation, the radio, and television. One must ever be learning new things if he is to keep abreast of the times, physically, socially, politically, and philosophically.

This is at once the setting and the need for adult education. It finds its justification in the facts of the psychology of learning and retention. Evidence was presented in Chapter 3 to show that no one up to the age of sixty years can find an excuse in his chronological age for failure to learn (*615*, 177-194). What decrease in speed and facility occurs with increasing years—and there is some loss—can be more than compensated for by knowledge of how to employ one's time to the best advantage and by interest in what one wishes to accomplish. The laws of learning for the adult are the same as those for the child and the youth, although they must, it is true, be applied with understanding and skill, and with somewhat greater flexibility (*614*).

NEW TOOLS IN EDUCATION

The educator had only begun to incorporate the motion picture into his techniques of instruction when the radio, with its almost unlimited potentialities in education, became available for his use. The adaptation of these two media of communication, the one visual and the other auditory, raises many important psychological problems. The former came at a time when attention was already being focused on visual aids in education and found ready acceptance on that account (*706*).

Cantril and Allport (*83*) have described the aspects of radio broadcasting that raise psychological problems in the education of the child and the adult. Those are of particular interest that relate to the adaptation of the radio to classroom instruction. Along with its recognized advantages, they cite numerous disadvantages. These do not, however, counterbalance the former and can be overcome by proper adaptation of the radio technique to this specific use. Among the advantages are the larger audience that can be reached, and at a lower cost per person;

the increased interest and entertainment value through dramatization and showmanship; the broadened outlook and inspiration that come from radio contact with better teachers. The disadvantages include the absence of visual aids; the lack of the personal touch of the teacher; the loss of opportunity on the part of the students to question the instructor and of the chance to make constructive suggestions; and the lack of opportunity to ask for repetition of what is not heard or understood. The mere recital of these disadvantages will suggest to the alert mind modifications of procedure that will tend to dissipate them.

The one fact that appears to be generally accepted is that the radio cannot be a substitute for the more usual types of classroom instruction, but should be employed as an adjunct to them. When used in this way, all the devices of outlines, discussions, questions, and reviews can be called into service. Moreover, when the radio is thus combined with the more customary modes of presentation, the question of the relative ease of learning by eye and by ear that has been the subject of so much research (*369*), will become relatively unimportant. The applied psychologist need scarcely be reminded that the relative advantages and disadvantages of the motion picture and the radio as compared with the traditional modes of instruction are not to be determined by mere inspection. These matters, as well as the multitude of specific problems which they raise, can be adequately dealt with only by the application of psychological knowledge and techniques such as it has been the purpose of this book to present.

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